PRACTICAL ORTHODONTIA

IN

PRACTICAL

ORTHODONTIA

BY

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TO

EDWARD H. ANGLE, M.D., D.D.S.

IN RECOGNITION OF THE INSPIRATION AND HELP

DERIVED FROM HIM

IN MY EARLY DAYS IN ORTHODONTIA

THIS VOLUME IS RESPECTFULLY DEDICATED

BY THE AUTHOR

PREFACE TO FOURTH EDITION

In the third edition of this work, published in 1917, considerable space was devoted to the use of the lingual arch, and attention was directed to the possibilities of the high labial arch with finger spring extension. During the two years that have elapsed since that time the author has continually used in his practice different forms of lingual arches and the high labial arch with finger spring extension, as well as experimented with other styles of appliances in clinical work. As a result of observations, both in his own practice and in the practice of others, he has reached the conclusion that the use of regulating appliances will necessarily be governed by the proficiency attained by certain men in the manipulation of certain types of appliances. The universal regulating appliance will never be possible until all men have attained the same degree of proficiency in the treatment of irregularities, the same mechanical and technical skill, and until all have mastered the same mechanical principles concerned in the construction and manipulation of appliances and in the production of anchorage. At the present time an appliance that is successful and ideal in the hands of one may not be so in the hands of another. It has been thoroughly demonstrated from observation in the practice of a number of orthodontists and in post-graduate and college work that the fundamental necessities in the practice of orthodontia are made up of a study of certain basic mechanical principles, and if these principles are mastered, regulating appliances will necessarily evolve in the hands of each man along these basic lines.

The author believes that for the orthodontist who has mastered mechanical principles and is skilled in orthodontic technic, the lingual arch used with the wire-stretching pliers offers many advantages and possibilities. However, the use of such an appliance in the hands of an inexperienced operator would not be satisfactory and probably would be detrimental to the patient. To those inexperienced in the use of soldered lingual arches, the removable lingual arch offers a safer technic, and the author would recommend its use until the practitioner has mastered the principles of the wire-stretching pliers, and then he can use the pinched or soldered lingual arch. An appliance that is easier to manipulate, and one that is inconspicuous and offers advantages in many cases, is the high labial arch with finger spring extensions and recurved extensions, as advocated by Dr. Lloyd S. Lourie. In the use of the high labial arch or the removable lingual arch a fundamental principle that

must be observed is that of anchorage. The author is convinced that many of the basic principles in any style of regulating appliance will be found in the study of anchorage. This has also been emphasized by Dr. Pullen.

The use of the lingual arches and the high labial arch requires a more perfected technique than does the use of the labial alignment wire with ligatures, therefore, to one who has treated few cases, this type of appliance is recommended, as less trouble will be experienced and better results accomplished. To the operator inexperienced in the use of the lingual arch, the Jackson removable appliance is to be recommended. Its simplicity of adaptation and its conservation of anchorage causes this to be an ideal appliance with which to begin the use of the lingual devices. Realizing that no one appliance is universal, the author has endeavored to describe the treatment of every type of malocclusion using different types of appliances.

In addition to those who contributed to the third edition of this work, the author is indebted to Dr. Lloyd S. Lourie for illustrations used to elucidate the technique of the lingual appliance and the high labial arch with spring extensions; to Dr. John V. Mershon, of the University of Pennsylvania, for suggestions in the use of the removable lingual arch with finger springs; and to Dr. W. W. Martin, of the University of Iowa, for his faithful cooperation in working out in clinical practice some of the mechanical principles.

An effort on the part of the author has been made to limit the book to such principles as have proved of value in practice, and it is hoped that this edition will render as great a service to orthodontists, students, and teachers as its predecessors have done.

M. D.

Chicago, Ill.

PREFACE TO THIRD EDITION

Since the first edition of this work was published in 1914, orthodontia has made many advances, and the author has endeavored to bring this third edition up to date. While the arrangement of the text remains practically the same as in the first edition, several new chapters and about four hundred new illustrations have been added. At its seventeenth annual meeting the American Society of Orthodontists adopted a new terminology, which differs from that used in the first edition of this work. The new terminology has been used throughout this edition in conjunction with the old in order to enable the student and the general practitioner to become familiar with the new.

Many notable advances have been made in regulating appliances with the result that the old expansion arch still remains the standard. However, in place of the labial alignment wire, Dr. Lloyd S. Lourie and Dr. John V. Mershon have introduced the lingual alignment wire, which makes a very inconspicuous appliance and deserves a place in orthodontia. More and more attention is being given to the correction of the teeth by the use of delicate appliances. The bodily movement of the teeth is also receiving more consideration than formerly. It has been shown that such movement can be accomplished with very delicate appliances; all that is necessary being an appliance that gives a two-point contact, and if the pressure is constant and in the right direction, the movement will be accomplished. The author has endeavored to show only such appliances as have proved valuable, or that have some feature recommending their use above all other appliances in particular cases.

The author is indebted to Dr. Oren A. Oliver, Professor of Orthodontia in the Dental Department of the Vanderbilt University, for a well illustrated description of the technique of facial cast construction. The chapter on facial deformities will be found of value, and the author desires to express his gratitude to Dr. B. E. Lischer, Professor of Orthodontics in the Dental Department of Washington University, for the many beautiful illustrations contained in this chapter. For the technique for duplication of models and the illustrations thereof, the author wishes to thank Dr. J. A. C. Hoggan, Professor of Orthodontia, School of Dentistry, Medical College of Virginia.

The science of orthodontia is indebted to Dr. Lourie and Dr. Mershon for the technique of the lingual arch, which, in the author's opinion, is one of the greatest advances made in recent years. The chapter on the use of the x-ray in orthodontia has been written by Dr. James David McCoy, professor of Orthodontia and Radiography, College of Dentistry, University of Southern California. Dr. Joseph D. Eby, of Atlanta, Ga., has furnished much of the material and illustrations for the chapter on the removable regulating appliance. The author also wishes to express his indebtedness to Dr. A. E. Suggett for a description of the use of the .0225 alignment wire. The chapter on malocclusion and nasal deformities is also a valuable addition to the work. Illustrations have been secured from numerous sources, to all of which recognition has been given.

This book is an endeavor to furnish a text of practical value to orthodontists, to students in dental colleges, and to teachers, and it is hoped that to these it will be of service.

M. D.

PREFACE TO FIRST EDITION

Believing that there should be a book more suited to the needs of the student of orthodontia than any which we now have, the author has attempted to include in this volume certain principles which he has found to partially fulfill, at least, the needs of his students.

Occlusion being the basis of orthodontia, much space has been devoted to the different forces of occlusion, and there has also been added a table giving the occlusion of each of the inclined planes of the teeth.

Classification has been based on the mesio-distal relation of the teeth and since Angle's plan of nomenclature appears to be the one most universally used, it has been adhered to. Under classification certain types have been included which are so different as to require a different technique in treatment.

Causes of malocclusion have been taken up under different headings and described.

Under appliances, the author has confined his discussion to those which have proved their worth and which he believes will be successful in the greatest number of cases. The principles of retention have been carefully explained, for undoubtedly much unnecessary trouble has resulted in the past by not taking into consideration the principles involved.

It has been the aim of the author to confine his discussion to the practical side of the question rather than to the historical features. Very little has been said about art as related to orthodontia. Neither has he dwelt upon the histological side of tooth movement or the development of bone, as these subjects should be taught by the chair of histology. Mention has been made of only such appliances as would be in keeping with physiological tooth movement and bone growth. The author has purposely omitted any reference to the disputed question of opening the suture as an aid to orthodontic treatment. These questions are still unsettled and therefore should not be incorporated in a work of this kind to confuse the student. Since a great many methods pertaining to orthodontia have been advanced by different authorities in the past, and as priority is often a matter of dispute, the author has not attempted to give credit for everything; neither does he claim originality for anything contained herein. While he has done certain things and advanced certain theories which were new to him at one time, others have done the same twenty years ago.

Lastly, this book is not supposed to be the final solution of all things pertaining to orthodontia, but is intended for those interested in the subject who may be helped as a result of some of the author's experience gained during a period of twelve years as a teacher of orthodontia.

M. D.

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PRACTICAL ORTHODONTIA

CHAPTER I

OCCLUSION

Orthodontia is the science that has for its object the correction of malocclusion of the teeth.

Malocclusion is a deviation from the normal to such an extent as to interfere with the functions of the teeth.

Normal occlusion is the relation of the inclined planes of the teeth as intended by nature.

Occlusion is the relation of the inclined planes of the teeth.

As orthodontia is the science that deals with the malocclusion of the teeth, it necessarily follows that a study of this subject includes a thorough understanding of the teeth as arranged by nature (Fig. 1). Each one of the teeth has a definite position in the dental arch, not only with the teeth of each individual arch, but also with those of the opposing arch (Fig. 2). To recognize malocclusion it is necessary that we be familiar with normal occlusion. Not only has each tooth a definite and positive relation with a tooth of the opposite arch, but each inclined plane of each cusp has a certain relation with the inclined plane of some other cusp. By a study of the anatomy of the teeth, we find each cusp to be made up and bounded by marginal ridges and developmental ridges and grooves. These ridges and grooves also separate the cusps into definite inclined planes. The occlusal inclined planes of the teeth are named from the surfaces toward which they face, and their names are derived from a combination of the four terms, mesial, distal, buccal, and lingual (Fig. 3). In studying the arrangement of the teeth, we find that the lower teeth are set one inclined plane in advance of the upper teeth. This is made possible because the lower central incisor is narrower than the upper central incisor. When we reach the upper canine, we find that the upper canine occludes with the lower canine and a portion of the lower first premolar. Passing from the buccal to the lingual, we

find that the upper teeth are one-half of a cusp to the buccal of the lower teeth (Fig. 4); that is, the lingual cusps of the upper molars and premolars occlude between the buccal and lingual cusps of the

Fig. 1.—Normal occlusion of teeth. (Summa.)

lower molars and premolars (Fig. 5). The buccal cusps of the lower molars and premolars occlude between the buccal and lingual cusps of the upper molars and premolars. By studying Figs. 1, 2, 4 and 5 some idea can be gained of their arrangement. Probably a much

Fig. 2.—Normal occlusion (Aztec skull). (Ketcham.)

better idea can be obtained by studying the diagram shown in Fig. 6. It becomes apparent that the inclined planes of the teeth are neces-

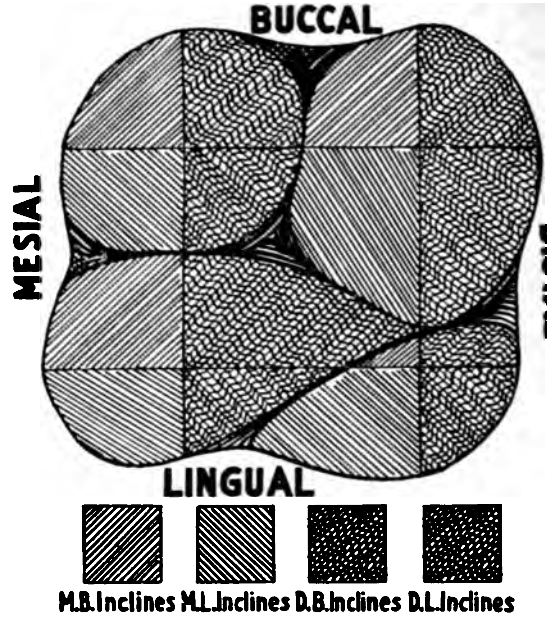


Fig. 3.—Showing occlusal inclined planes of the cusps.

sarily arranged diagonally to the mesio-distal relation of the arches. They are named mesio-buccal, mesio-lingual, disto-buccal and disto-

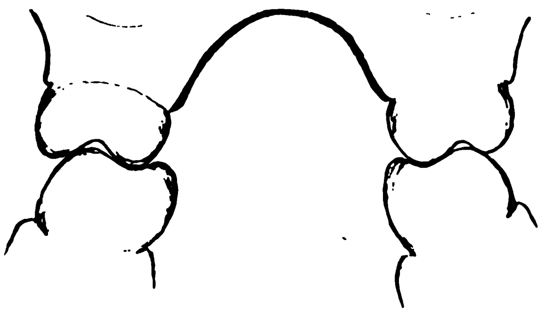


Fig. 4.—Buccal and lingual relation of molars.

lingual. A point to be remembered in studying the occlusion of the teeth is that the mesio-buccal cusp of the upper first molar occludes

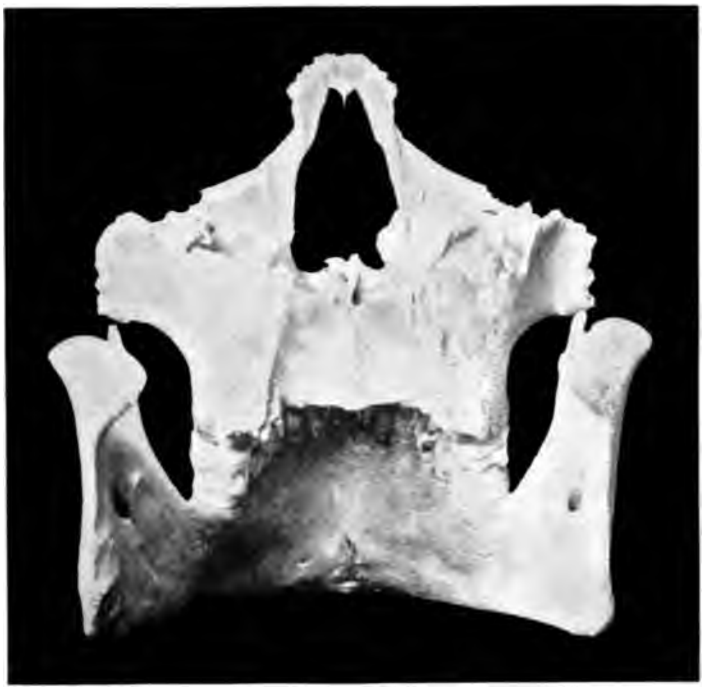


Fig. 5.—Shows relation of lingual cusps of upper molar to lower.

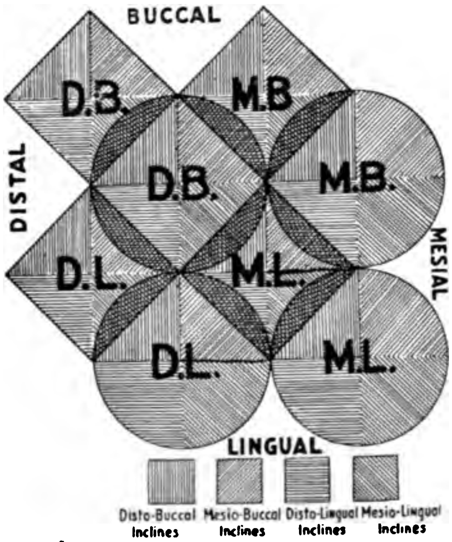


Fig. 6.—Shows relation of cusps and inclined planes. Upper cusps, square; lower cusps, round. Note position of mesio-lingual cusp of upper molar and disto-buccal cusp of lower.

in the buccal groove of the lower first molar. This arrangement is found on all of the molar teeth. The mesio-lingual cusps of the maxillary molars occlude in the central fossæ of the corresponding mandibular molars. The mesio-lingual cusp of the maxillary molar is surrounded by the four cusps of the corresponding mandibular molar. The disto-buccal cusp of the mandibular molar occludes in the corresponding central fossa of the maxillary molar, which makes the disto-buccal cusps of

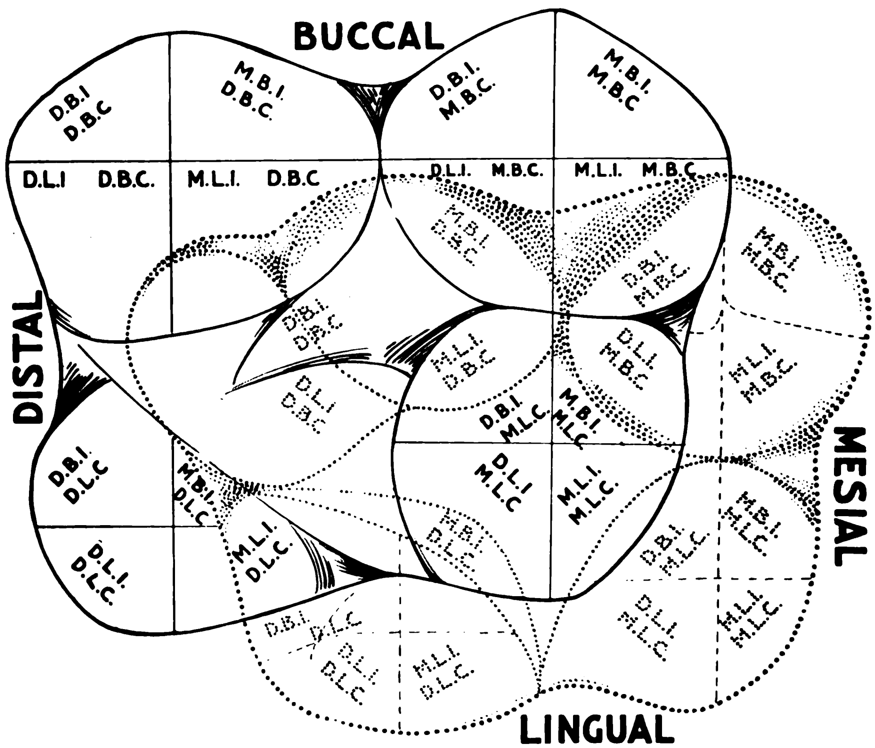


Fig. 7.—Maxillary and mandibular molar, showing mesio-lingual cusp in central fossa of mandibular molar. Initial letters of cusps and inclines used; e. g., M.B.I.—D.B.C. refers to mesio-buccal incline of disto-buccal cusp.

the mandibular molars surrounded by the four cusps of the corresponding maxillary molars. However, in the case of the mandibular first molar, which has a disto-buccal and distal cusp, the arrangement is a little different; but ordinarily we consider the disto-buccal and distal cusp as one cusp. Another point to remember is that the lingual surfaces of the lingual cusps of the mandibular molars and premolars are also without occlusion.

The occlusion of the inclined planes of the maxillary teeth with the mandibular is given in the following table. The left-hand column contains cusps of the upper teeth, while the right-hand column refers to the lower teeth. By reading the left-hand column first we are given the occlusion of the maxillary teeth with the mandibular, and by reading the right-hand column first we are given the occlusion of the mandibular teeth with the maxillary. It is necessary that they who expect to treat malocclusion must know the relation of the inclined planes of each cusp or it will be absolutely impossible to diagnose and treat correctly malocclusion of the teeth.

Table Showing Occlusion of Inclined Planes

MAXILLARY TEETH		MANDIBULAR TEETH
The occlusal lingual third of the maxillary first (central) incisor.	occludes with	the labial occlusal third of the mandibular first (central) incisor and the mesio-labial half of the occlusal surface of the mandibular second (lateral) incisor.
The occlusal lingual third of the maxillary second (lateral) incisor	occludes with	the disto-labial occlusal surface of the mandibular second (lateral) incisor and the mesio-labial incline of the mandibular canine (cuspid).
The mesio-lingual inclined plane of the maxillary canine (cuspid).	occludes with	the disto-buccal inclined plane of the mandibular canine (cuspid).
The disto-lingual inclined plane of the maxillary canine (cuspid).	occludes with	the mesio-buccal inclined plane of the buccal cusp of the mandibular first premolar (bicuspid).
The mesio-lingual inclined plane of the buccal cusp of the maxillary first premolar (bicuspid)	occludes with	the disto-buccal inclined plane of the buccal cusp of the mandibular first premolar (bicuspid).
The disto-lingual inclined plane of the buccal cusp of the maxillary first premolar (bicuspid)	occludes with	the mesio-buccal inclined plane of the buccal cusp of the mandibular second premolar (bicuspid).
The mesio-buccal inclined plane of the lingual cusp of the maxillary first premolar (bicuspid)	occludes with	the disto-lingual inclined plane of the buccal cusp of the mandibular first premolar (bicuspid).
The mesio-lingual inclined plane of the lingual cusp of the maxillary first premolar (bicuspid)	occludes with	the disto-lingual inclined plane of the lingual cusp of the mandibular first premolar (bicuspid). (This cusp is often underdeveloped.)

MAXILLARY TEETH		MANDIBULAR TEETH
The disto-buccal inclined plane of the lingual cusp of the maxillary first premolar (bicuspid)	occludes with	the mesio-lingual inclined plane of the buccal cusp of the mandibular second premolar (bicuspid).
The disto-lingual inclined plane of the lingual cusp of the maxillary first premolar (bicuspid)	occludes with	the mesio-buccal inclined plane of the lingual cusp of the mandibular second premolar (bicuspid).
The mesio-lingual inclined plane of the buccal cusp of the maxillary second premolar (bicuspid)	occludes with	the disto-buccal inclined plane of the buccal cusp of the mandibular second premolar (bicuspid).
The disto-lingual inclined plane of the buccal cusp of the maxillary second premolar (bicuspid)	occludes with	the mesio-buccal inclined plane of the mesio-buccal cusp of the mandibular first molar.
The mesio-buccal inclined plane of the lingual cusp of the maxillary second premolar (bicuspid)	occludes with	the disto-lingual inclined plane of the buccal cusp of the mandibular second premolar (bicuspid).
The mesio-lingual inclined plane of the lingual cusp of the maxillary second premolar (bicuspid)	occludes with	the disto-buccal inclined plane of the lingual cusp of the mandibular second premolar (bicuspid).
The disto-buccal inclined plane of the lingual cusp of the maxillary second premolar (bicuspid)	occludes with	the mesio-lingual inclined plane of the mesio-buccal cusp of the mandibular first molar.
The disto-lingual inclined plane of the lingual cusp of the maxillary second premolar (bicuspid)	occludes with	the mesio-buccal inclined plane of the mesio-lingual cusp of the mandibular first molar.
The mesio-lingual inclined plane of the mesio-buccal cusp of the maxillary first molar	occludes with	the disto-buccal inclined plane of the mesio-buccal cusp of the mandibular first molar.
The disto-lingual inclined plane of the mesio-buccal cusp of the maxillary first molar	occludes with	the mesio-buccal inclined plane of the disto-buccal cusp of the mandibular first molar.
The mesio-buccal inclined plane of the mesio-lingual cusp of the maxillary first molar	occludes with	the disto-lingual inclined plane of the mesio-buccal cusp of the mandibular first molar.
The mesio-lingual inclined plane of the mesio-lingual cusp of the maxillary first molar	occludes with	the disto-buccal inclined plane of the mesio-lingual cusp of the mandibular first molar.
The disto-buccal inclined plane of the mesio-lingual cusp of the maxillary first molar	occludes with	the mesio-lingual inclined plane of the disto-buccal cusp of the mandibular first molar.

MAXILLARY TEETH		MANDIBULAR TEETH
The disto-lingual inclined plane of the mesio-lingual cusp of the maxillary first molar.	occludes with	the mesio-buccal inclined plane of the disto-lingual cusp of the mandibular first molar.
The mesio-lingual inclined plane of the disto-buccal cusp of the maxillary first molar	occludes with	the disto-buccal inclined plane of the disto-buccal cusp of the mandibular first molar.
The disto-lingual inclined plane of the disto-buccal cusp of the maxillary first molar	occludes with	the mesio-buccal inclined plane of the mesio-buccal cusp of the mandibular second molar.
The mesio-buccal inclined plane of the disto-lingual cusp of the maxillary first molar	occludes with	the disto-lingual inclined plane of the disto-buccal cusp of the mandibular first molar.
The mesio-lingual inclined plane of the disto-lingual cusp of the maxillary first molar	occludes with	the disto-buccal inclined plane of the disto-lingual cusp of the mandibular first molar.
The disto-buccal inclined plane of the disto-lingual cusp of the maxillary first molar	occludes with	the mesio-lingual inclined plane of the mesio-buccal cusp of the mandibular second molar.
The disto-lingual inclined plane of the disto-lingual cusp of the maxillary first molar	occludes with	the mesio-buccal inclined plane of the mesio-lingual cusp of the mandibular second molar.
The mesio-lingual inclined plane of the mesio-buccal cusp of the maxillary second molar	occludes with	the disto-buccal inclined plane of the mesio-buccal cusp of the mandibular second molar.
The disto-lingual inclined plane of the mesio-buccal cusp of the maxillary second molar	occludes with	the mesio-buccal inclined plane of the disto-buccal cusp of the mandibular second molar.
The mesio-buccal inclined plane of the mesio-lingual cusp of the maxillary second molar	occludes with	the disto-lingual inclined plane of the mesio-buccal cusp of the mandibular second molar.
The mesio-lingual inclined plane of the mesio-lingual cusp of the maxillary second molar	occludes with	the disto-buccal inclined plane of the mesio-lingual cusp of the mandibular second molar.
The disto-buccal inclined plane of the mesio-lingual cusp of the maxillary second molar........	occludes with	the mesio-lingual inclined plane of the disto-buccal cusp of the mandibular second molar.
The disto-lingual inclined plane of the mesio-lingual cusp of the maxillary second molar........	occludes with	the mesio-buccal inclined plane of the disto-lingual cusp of the mandibular second molar.

MAXILLARY TEETH		MANDIBULAR TEETH
The mesio-lingual inclined plane of the disto-buccal cusp of the maxillary second molar	occludes with	the disto-buccal inclined plane of the disto-buccal cusp of the mandibular second molar.
The disto-lingual inclined plane of the disto-buccal cusp of the maxillary second molar	occludes with	the mesio-buccal inclined plane of the mesio-buccal cusp of the mandibular third molar.
The mesio-buccal inclined plane of the disto-lingual cusp of the maxillary second molar	occludes with	the disto-lingual inclined plane of the disto-buccal cusp of the mandibular second molar.
The mesio-lingual inclined plane of the disto-lingual cusp of the maxillary second molar	occludes with	the disto-buccal inclined plane of the disto-lingual cusp of the mandibular second molar.
The disto-buccal inclined plane of the disto-lingual cusp of the maxillary second molar	occludes with	the mesio-lingual inclined plane of the mesio-buccal cusp of the mandibular third molar.
The disto-lingual inclined plane of the disto-lingual cusp of the maxillary second molar	occludes with	the mesio-buccal inclined plane of the mesio-lingual cusp of the mandibular third molar.
The mesio-lingual inclined plane of the mesio-buccal cusp of the maxillary third molar	occludes with	the disto-buccal inclined plane of the mesio-buccal cusp of the mandibular third molar.
The disto-lingual inclined plane of the mesio-buccal cusp of the maxillary third molar	occludes with	the mesio-buccal inclined plane of the disto-buccal cusp of the mandibular third molar.
The mesio-buccal inclined plane of the mesio-lingual cusp of the maxillary third molar	occludes with	the disto-lingual inclined plane of the mesio-buccal cusp of the mandibular third molar.
The mesio-lingual inclined plane of the mesio-lingual cusp of the maxillary third molar	occludes with	the disto-buccal inclined plane of the mesio-lingual cusp of the mandibular third molar.
The disto-buccal inclined plane of the mesio-lingual cusp of the maxillary third molar	occludes with	the mesio-lingual inclined plane of the disto-buccal cusp of the mandibular third molar.
The disto-lingual inclined plane of the mesio-lingual cusp of the maxillary third molar	occludes with	the mesio-buccal inclined plane of the disto-lingual cusp of the mandibular third molar.
The mesio-lingual inclined plane of the disto-buccal cusp of the maxillary third molar	occludes with	the disto-buccal inclined plane of the disto-buccal cusp of the mandibular third molar.

MAXILLARY TEETH		MANDIBULAR TEETH
The disto-lingual inclined plane of the disto-buccal cusp of the maxillary third molar	occludes with	nothing.
The mesio-buccal inclined plane of the disto-lingual cusp of the maxillary third molar	occludes with	the disto-lingual inclined plane of the disto-buccal cusp of the mandibular third molar.
The mesio-lingual inclined plane of the disto-lingual cusp of the maxillary third molar	occludes with	the disto-buccal inclined plane of the disto- lingual cusp of the mandibular third molar.
The disto-buccal inclined plane of the disto-lingual cusp of the maxillary third molar	occludes with	nothing.
The disto-lingual inclined plane of the disto-lingual cusp of the maxillary third molar	occludes with	nothing.

The tip of the lingual cusp of the maxillary premolar does not occlude between the mandibular premolars but occludes in the distal portion of the central fossa of the mandibular first premolar. The tip of the lingual cusp of the maxillary second premolar occludes in the distal portion of the central fossa of the mandibular second premolar.

The maxillary premolars are so placed in the upper arch that a line drawn through the buccal and lingual cusps of the right premolars would also touch the buccal and lingual cusps of the corresponding teeth on the left side.

The mandibular premolars are so placed that lines drawn through the buccal and lingual cusps of the right and left teeth would cross at almost a right angle at a point distal to the teeth.

NOTE—The author prefers the terms *first* and *second* incisors to those of *central* and *lateral* as it is in keeping with first and second molars, etc. The terms *canines* and *premolars* are also more scientific and descriptive than *cuspids* and *bicuspids*. To avoid confusion both terms are given in the table.

CHAPTER II

FORCES OF OCCLUSION

It has been shown that each cusp has a definite relation to the opposing cusp, which relation we have termed "occlusion." Each tooth is held in a proper position by what we call "forces of occlusion."

Definition.—Forces of occlusion are those factors which when acting normally cause teeth to assume and maintain their position in the line of occlusion..

Line of Occlusion.—The line of occlusion is that line with which, in form and position according to type, the teeth must be in harmony if in normal occlusion (Angle). The line of occlusion can also be defined as the line of the greatest occlusal contact. As each tooth begins to make its appearance from the dental crypt and gum it is guided to a certain position in the dental arch. If all of the forces of occlusion are acting normally, the tooth will take its proper position, and if the same forces of occlusion act normally during the time that the entire dental apparatus is forming, all of the teeth will be in their proper positions. However, should one of the forces of occlusion become abnormal the result will be malocclusion. The failure of any one of the teeth to take the proper position in the line of occlusion will influence some other tooth or teeth and malocclusion will result.

Classification of Forces of Occlusion

There are six forces of occlusion, or factors of occlusion, as follows:

1. Normal cell metabolism.
2. Muscular pressure.
3. Force of the inclined plane.
4. Normal approximal contact.
5. Harmony in the size of the arches.
6. Atmospheric pressure.

Normal Cell Metabolism.—That normal cell metabolism is given first, does not necessarily mean that it is the most important force, for we cannot have any one of the forces abnormal and still have normal occlusion of the teeth. These forces are given as nearly as

Fig. 8.—Half of the superior maxilla, showing the growth downward and forward of the alveolar process and palate. (After Noyes.)

possible in the order that they make their appearance during the time the dental apparatus is developing.

Normal cell metabolism may be defined as the proper physiologic development of the cells that have to do with the eruption of the teeth and the development of the surrounding parts. If a child is developing normally (Fig. 8), we will have calcifications at the end of the tooth germ, causing an increase in the length of the root and absorption of the bone forming the dental crypt, and the development of the peridental membrane. In fact, it is the cell activity of that particular region which causes the tooth to erupt. Therefore, cell metabolism is the first force which causes the teeth to assume the proper position in the dental arch.

Fig. 9.—Malocclusion of central produced by abnormal locking of inclined planes.

Muscular Pressure.—It also generally follows that teeth, when they first erupt, do not always occupy their proper position. They may be too far to the buccal or lingual side of the arch. However, the second force of occlusion, muscular pressure, aids the tooth to take very nearly the proper position in regard to the buccal and lingual relation to the line of occlusion. Should the central incisor erupt too far toward the lingual, the pressure of the tongue will force it labially. Should it be too far toward the labial, the pressure of the lips will force it lingually. As a result of the activity of the muscles of the cheeks and tongue, we find that each one of the deciduous teeth is caused to assume a position in the arch in response to those forces. The muscles of mastication also influence the position of the teeth

through the relation of the inclined planes. Therefore, muscular pressure is the second force that has an action upon the teeth that causes

Fig. 10.—The position of first molars at this age easily permits of abnormal locking of cusps.

Fig. 11.—Left side of model shown in Fig. 10.

them to take their proper position. If everything is developing normally, from this time on the other four forces of occlusion act so nearly

together that it is almost impossible to say which exerts an influence first or which is the most important.

Force of the Inclined Plane.—The author is inclined to believe that the third force, or the force of the inclined plane, is the next one to

Fig. 12.—Abnormal locking of first molars will produce other malocclusions as age advances.

Fig. 13.—Showing abnormal approximal contacts of teeth and the influence of one tooth on the others.

be an important factor as the teeth erupt. The force of muscular pressure has caused the maxillary and mandibular teeth to be placed in an arch which is about the shape of the tongue and which corresponds

with the range of the activity of the muscles of the cheek and lip. As the maxillary and mandibular teeth approach each other, we find that

Fig. 14.

Fig. 15.

Figs. 14 and 15.—Showing abnormal locking of teeth and abnormal approximal contacts. The maxillary right second premolar (bicuspid) and maxillary left canine (cuspid) are crowded lingually because of abnormal approximal contact.

the inclined planes of the cusps of the occlusal surface come in contact, act in the nature of a wedge, and force the teeth to such a position

that the cusps of the mandibular teeth will fall in the grooves and sulci of the maxillary teeth and the cusps of the maxillary teeth will fall in the

Fig. 16.

Fig. 17.

Figs. 16 and 17.—Show malocclusion resulting from missing left maxillary second premolar (bicuspid), resulting in inharmony in size of arches.

fossæ and grooves of the mandibular teeth (Fig. 9). It has been shown that the mesio-lingual cusp of the maxillary molar occludes in the central

fossa of the corresponding mandibular molar; also that the buccal cusps of the maxillary molars and premolars are buccal to the mandibular molars and premolars. Seldom do we find each cusp occupying its proper position when the cusps of the teeth first come in contact; but owing to the act of mastication, the cusps force themselves into the proper place, provided that they have started in the right direction (Fig. 10). However, should one cusp be locked on the wrong incline it becomes a factor in producing malocclusion (Fig. 12), and instead of a normal occlusion of the teeth there will be malocclusion. The force of the inclined plane is active, from the teeth in one arch to the teeth in the opposite arch.

We have stated that the forces of occlusion are closely related, and

Fig. 18.—Malocclusion produced by missing lateral.

this is especially true in regard to the force of the inclined plane and that of muscular pressure. Muscular pressure has been defined as the force exerted by the muscles of the lips and cheeks upon the teeth. This action is derived from the muscles of respiration, deglutition and expression. These groups of muscles exert a direct force upon the teeth, which is different from the force exerted upon the teeth by the muscles of mastication. The muscles of mastication exert force on the teeth only through the medium of the inclined planes, and it is this action of the muscles that are attached to the ramus which causes the force of the inclined plane to be an active force. Therefore, in studying the

forces of occlusion we must ever bear in mind the intimate relation that exists between the one and the others.

Normal Approximal Contact.—The force of the approximal contact is the force that the approximating surfaces of the teeth of one arch exert on the approximating surfaces of the same arch. It is different from the forces of the inclined plane, as it acts only upon approximating teeth. For a number of years we failed to realize that there were certain cases in which the force of the inclined plane would be normal but the force of the approximal contact abnormal, resulting in troublesome types of malocclusion, the treatment of which can only be successfully accomplished by recognizing the relation of the approximal contact points (Fig. 13). After one tooth in either arch erupts, it has a guiding influence on the approximating tooth, helping

Fig. 19.

Fig. 20.

Figs. 19 and 20.—Showing missing mandibular second premolar (bicuspid).

to produce either normal occlusion or malocclusion. If two teeth have erupted and the space remains between them for the third tooth, the third tooth is influenced by the approximating tooth on its mesial and distal side (Figs. 14 and 15). The force of the approximal contact is probably more important in the eruption of the permanent teeth than it is in the eruption of the deciduous teeth. It therefore becomes necessary that the normal approximal contact of the deciduous teeth must be maintained in order that the permanent teeth will erupt in their proper position in the dental arch. A great many cases of malocclusion are produced in the permanent teeth because this condition has been overlooked.

Harmony in the Size of the Arches.—"Harmony in the size of the

arches" means that the teeth in the upper arch and the teeth in the lower arch are so arranged that when in normal occlusion, each one occupying the proper position in the line of occlusion, the line of greatest occlusal contact will be the same in both arches. If there is one more tooth in the lower than in the upper arch (Figs. 16, 17, and 18), it necessarily will produce inharmony in the size of the arches, resulting in malocclusion. Likewise, if there is a missing tooth in the lower arch, malocclusion of the upper arch will result (Figs. 19 and 20). Malocclusion may be produced by inharmony in the size of the arches when the inharmony is the result of the decay of the teeth,

Fig. 21.—Inharmony in size of maxillary and mandibular teeth. (Hawley.)

causing destruction of the approximal contact. Inharmony in the size of the arches may be the result of inharmony in the size of the teeth. One or more teeth may be too large or too small. Cases are on record where the mandibular incisors are too large for the maxillary incisors, thereby making the establishment of normal occlusion and a normal overbite impossible, on account of the abnormal approximal contact (Fig. 21). In other cases it has been found that the maxillary incisors would be too large as compared with the mandibular incisors. Sometimes the inharmony in the size of the teeth may be in the premolars or canines. In those cases where the inharmony as to size exists in the incisor region, the molars and premolars may be in normal relation

with each other and the occlusion of the lateral halves may be normal, and it is possible to establish a normal occlusion in the molar and premolar region with a normal relation of the inclined planes and normal approximal contact of the premolars and molars and have a compromise occlusion of the incisors. There may be a slight overlapping, a slight spacing, or a too short or too great overbite, which is the result

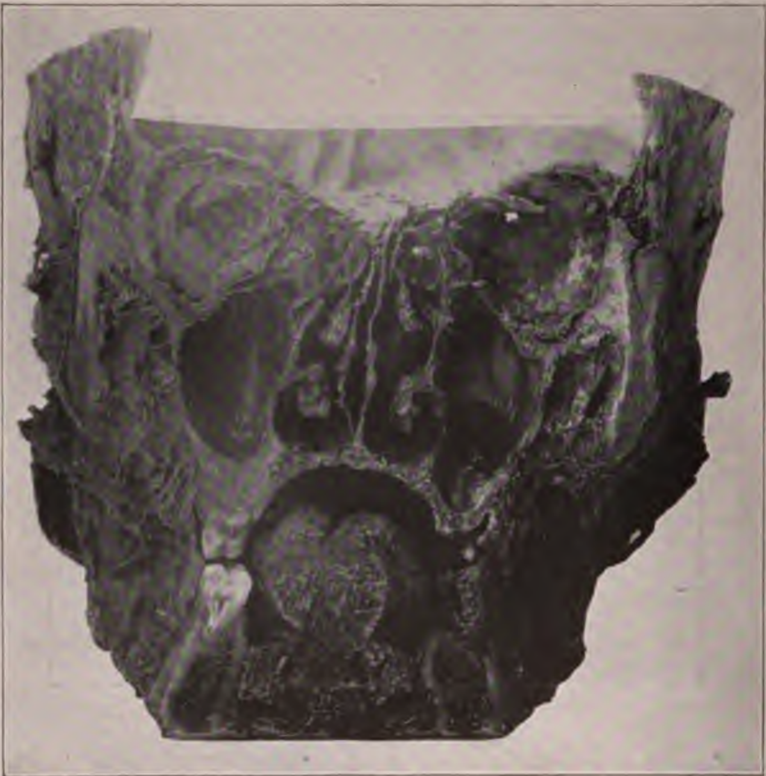


Fig. 22.—Posterior portion of nasal cavity and sinuses. Note position of lingual cusp of upper molar.

of inharmony in the size of the arches and which must be considered as a force of occlusion that will always assert itself in some way. If there is an inharmony in the size of teeth it can be compensated by grinding the tooth so as to reduce the mesio-distal diameter and thereby establish new approximal contacts and a harmony in the size of the arches. This inharmony in the size of the teeth was first called to my attention by Hawley and has later been proved by the work of Stanton, Rudolph

Hanau, and Gilbert D. Fish. Their work proves that the forces of occlusion cannot be overlooked if we hope to establish normal occlusion.

So it will be seen that very often in the loss of one of the forces of occlusion a second one is also disturbed, finally causing an inharmonious action of all of them.

Fig. 23.—Typical case of malocclusion by mouth-breathing.

Fig. 24-A.

Fig. 24-B.

Figs. 24-A and 24-B.—Facial deformity associated with mouth-breathing.

Normal Atmospheric Pressure.—By normal atmospheric pressure is meant the atmospheric relations or conditions which exist in the nasal and oral cavities during normal breathing, and the changes which occur in deglutition and when speaking.

With the lips closed and after swallowing, the soft palate is in contact with the posterior portion of the tongue, and a vacuum is created between the center of the tongue and the center of the roof of the mouth. As a result of this, the air from the nasal cavities makes a downward pressure on the floor of the nose, and becomes a factor in the downward development of the roof of the mouth. The air pressure is also exerted on the soft tissue beneath the chin: namely, the muscles running from the mandible to the hyoid bone, and the soft tissues are held in place or pushed upward, which gives a square effect to the chin that is present in the normal breather and not found in the mouth-breather. The mandible is also held in place by this atmospheric pressure, as a result of a vacuum created between the tongue and the roof of the mouth, and is not held in position by the muscular action of the elevators of the mandible or the muscles of mastication, which can be proved by the simple experiment of separating the lips and breathing through the mouth, and noting the difficulty in keeping the mandible in position. If the individual breathes through the nose, with each inspiration and expiration a pressure is exerted on all sides of the nasal cavity. Not only is a pressure exerted in the nasal cavity, but it is also produced in all of the nasal sinuses (Fig. 22). As a result of atmospheric pressure the nasal cavity is developed to its proper size, consequently this pressure plays an important part in the development of the dental arch. In normal breathing, the proper action of the muscles of the lips, cheeks and tongue is present, which results in the proper muscular pressure; there fore, with the loss of normal breathing, muscular pressure is disturbed, causing two forces of occlusion to be perverted. Such resulting malocclusions as we find in distoclusion with labioversion of the maxillary anterior teeth (Fig. 23) are primarily the result of disturbed atmospheric pressure and abnormal pressure of the cheeks, lips, and tongue (Fig. 24). Another very important phase of atmospheric pressure or conditions and muscular action takes place after we cease speaking—we close the lips and swallow; a vacuum is created in the oral cavity which in turn forces the tongue up against the roof of the mouth and exerts pressure upon the maxillary and mandibular teeth. In mouth-breathing the tongue exerts a pressure only on the mandibular arch and mostly upon the mandibular molars and premolars. Atmospheric pressure is an active force during the whole time that the individual is breathing. If at any time breathing becomes abnormal and the atmospheric pressure is disturbed, malocclusion will result. Should children become mouth-breathers early, malocclusion will develop shortly

after the mouth-breathing begins. Any of these forces of occlusion acting in the wrong direction then become forces of malocclusion. Acquired cases of malocclusion are simply the result of some condition that has resulted from one or more of the forces of occlusion that have been disturbed. Therefore, it becomes imperative that any effort toward the correction of malocclusion must be of such a nature that it will not only place the teeth in their proper position in the line of occlusion but, if they are expected to stay there, all six of the forces of occlusion must be normal and remain normal.

APTER III

OCCLUSION

from normal occlusion to such an ex-
oper functions of the teeth.
into four groups: First, positions of
the relation of the tooth to the ap-
plane of occlusion, and the median line
group "malpositions of the individual
the relation of one arch to the other,
which is based on the antero-posterior
ion of the mandibular arch to the max-
malposition of the mandible," which is
andible bears to the face and cranium,
condyle bears to the glenoid fossa. The
formation of the jaws and processes,"
the mandible and maxillæ.

n, or Malpositions of the Teeth

deal with the individual teeth or the
ch to the approximating teeth of the
alocclusion may be defined as the rela-
the line or plane of occlusion and the

on this subject, we might again state
line with which, in form and position
ust be in harmony if in normal occlu-

ions of malocclusion (Fig. 25), named
occupy to the line or plane of occlusion
e. The line of occlusion is divided into
median line of the face.
median line of the face or too far to-
said to be in *mesial occlusion* or *mesio-*

nding "version" to apply to the malposition of the
occlusion, the latter term being limited by Lischer

One that is too far in the opposite direction or toward the posterior portion of the arch is in *distal occlusion*, or *distoversion.*

A tooth that is too far toward the lips or cheeks is in *labial* or *buccal occlusion,* or *labioversion* or *buccoversion.* Labial occlusion or labioversion is applied to the six anterior teeth and buccal occlusion, or buccoversion, to the posterior teeth.

A tooth that is too far to the lingual side of the line of occlusion is said to be in *lingual occlusion,* or *linguoversion.*

One that is too short, that is, that has not erupted far enough to reach the plane of occlusion, is in *infra-occlusion,* or *infraversion.*

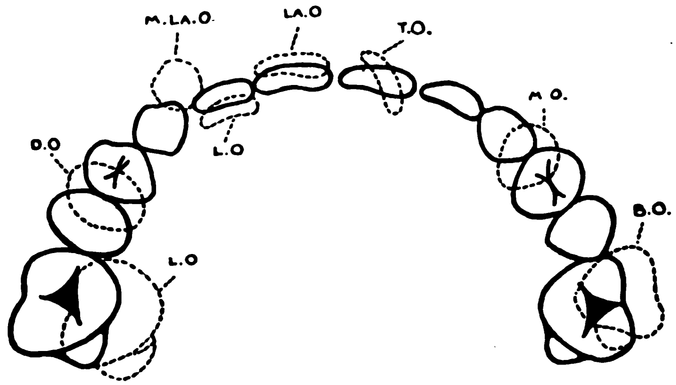


Fig 25.—Positions of malocclusion. Heavy black lines indicate normal position. Dotted lines indicate positions of malocclusion.
La. O.—Labial occlusion. Labioversion.
L. O.—Lingual occlusion. Linguoversion.
T. O.—Torsi-occlusion. Torsiversion.
D. O.—Distal occlusion. Distoversion.
M. O.—Mesial occlusion. Mesioversion.
B. O.—Buccal occlusion. Buccoversion.
M. La. O.—Mesio-labial occlusion. Mesiolabioversion.

One that has grown too long is in *supra-occlusion,* or *supraversion.*

A tooth that does not occupy a proper axis in the line of occlusion is said to be in *torsi-occlusion,* or *torsiversion,* that is, rotated on its axis.

Lischer suggests the term *transversion* for teeth that are transposed; for example, when the canine is between the premolars. He also uses the term *perversion* for impacted teeth.

We also have various combinations of these positions, for a tooth may be too far mesial and also rotated; it would then be in *torsi-mesioversion.* Likewise, it may be in any of the other four positions. A tooth may be in mesial occlusion, or *mesioversion,* not erupted far enough and also rotated, in which case it would be in *mesio-torsi-infra-occlusion,* or *mesio-*

torsi-infraversion. Various combinations will result from various positions of the teeth. A tooth may be too far mesial, may be rotated, may be in infra-occlusion, or infraversion, and also occupy a labial position, in which case it is spoken of as being in *mesio-labio-torsi-infra-occlusion,* or as being in *mesio-labio-torsi-infraversion.*

Fig. 26-A.

Fig. 26-B.

Figs. 26-A and 26-B.—Maxillary and mandibular molars and premolars are in linguoversion. Lateral incisors are in linguo-torsioversion.

With the seven primary positions of malocclusion it is possible for a tooth to occupy four of them at one time. To move a tooth into the proper position, it would necessarily have to be moved in four different directions. So positions of malocclusion while comparatively simple offer various complications in treatment (Fig. 26).

Classification of Malocclusion, or Malrelation of the Arches

Classes of malocclusion deal with the relation of the mandibular teeth to the maxillary teeth. Of course, the positions of malocclusion have some relation in the formation of the class, the principal one being the mesial and distal (anterior and posterior) relation of the arches. We have shown in the study of normal occlusion that the mesio-buccal cusp

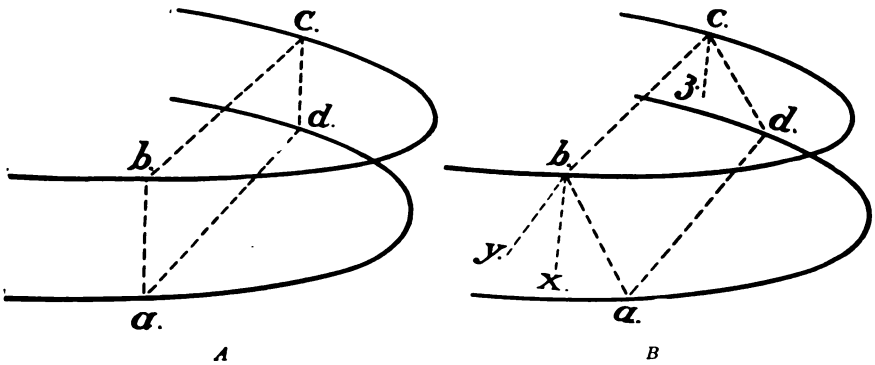


Fig. 27.—Diagram *A* illustrates normal arch relationship. In Diagram *B*, the parallelogram *a*, *b*, *c*, *d*, illustrates arch malrelation in bilateral mesioclusion, and *b*, *y*, their relation in bilateral distoclusion. (Lischer.)

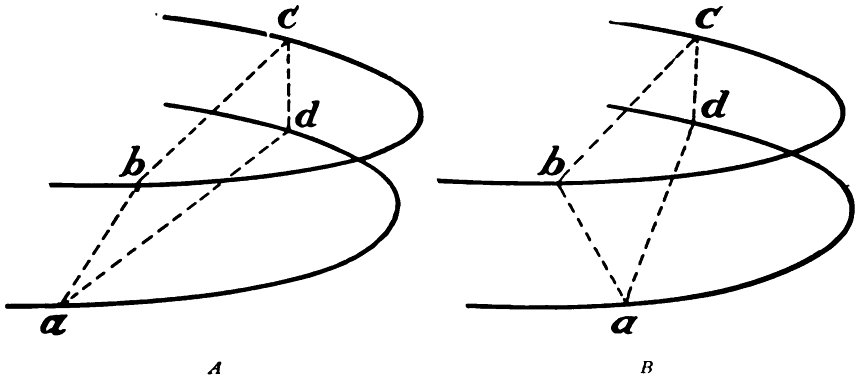


Fig. 28.—Diagrams illustrating arch malrelations in unilateral distoclusion and unilateral mesioclusion. (Lischer.)

of the maxillary first molar occludes in the buccal groove of the mandibular first molar. Also, the mesio-lingual cusp of the maxillary first molar falls into the central fossa of the mandibular first molar. The maxillary canine occludes between the mandibular canine and the mandibular first premolar. The relation of the mesio-buccal cusp of the maxillary first molar to the buccal groove has been called by Angle the

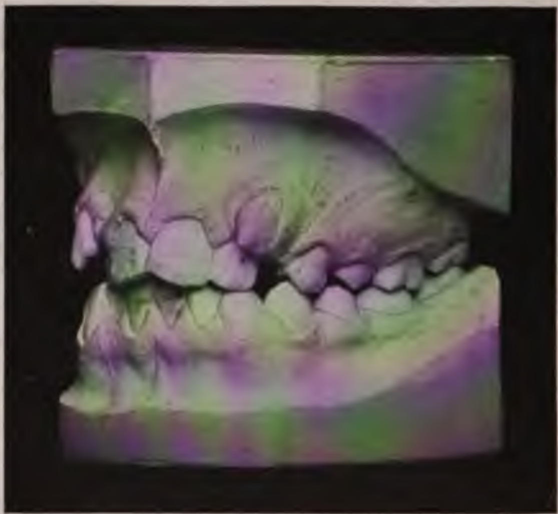


Fig. 29.—Neutroclusion, or Class I (Angle), showing normal mesio-distal (antero-posterior) relation of arches.

Fig. 30.—Another type of neutroclusion or normal mesio-distal (antero-posterior) relation of arches.

"Key to Occlusion." Other cusps are just as important, but we must select some definite points and keep them in mind in deciding whether the teeth occupy a proper mesio-distal relation to the opposing teeth. We must take into consideration more than one tooth in order that we may decide whether the dental arches occupy their proper mesio-distal (antero-posterior) relation to each other, for classification of malocclusion depends upon whether the arches occupy a normal mesio-distal relation or are too far forward or too far back. As the mandibular teeth are the movable arch, we speak of them as being in normal mesio-distal (antero-posterior) relation to the upper arch, or as being in distal (posterior) relation to the upper arch, or as being in mesial (anterior) relation to the upper arch. Following this plan, malocclusion of the arches can therefore be divided into three general classes. By three classes, we mean that in all cases of malocclusion the lower arch must either be normal mesio-distally, or the lower arch distal (posterior) or mesial (anterior) to the upper. Therefore, one group of cases would include those in which there is a distal (posterior) relation of the lower arch to the upper, and another group would include those in which the mandibular teeth are mesial (anterior) to the upper, while still another group would include all of those cases in which the lower arch is neither mesial (anterior) nor distal (posterior), but is normal in these relations.

The mesio-distal relation of the arches can be illustrated by the use of curves or arches that represent the upper and lower dental arch. In Fig. 28 *b-c* represents the upper arch and *a-d* the lower arch. The Diagram A represents the normal mesio-distal (antero-posterior) relation of the arches. The lines *a* to *b* and *c* to *d* represent the normal relation of the lower arch to the upper. In Diagram B the lines *a* to *b* and *c* to *d* represent what would happen if the lower arch was moved forward or mesially. The lines *b* to *y* and *c* to *w* represent the relations of the lower arch to the upper if a distal or backward movement was to take place. Cases of malocclusion that involve the mesial or distal malposition of the arches are spoken of as bilateral cases. In some instances the lower arch is shifted forward or backward on one side only. Diagram A, Fig. 28, shows the change in the lines *a* to *b* in the distal or backward movement of the lower arch on one side as compared with the normal relations as shown in Diagram A, Fig. 27. Diagram B, Fig. 28, to show the change that would occur in the mesial or forward movement of one side of the arch, compare the lines *a* to *b* (Diagram B, Fig.

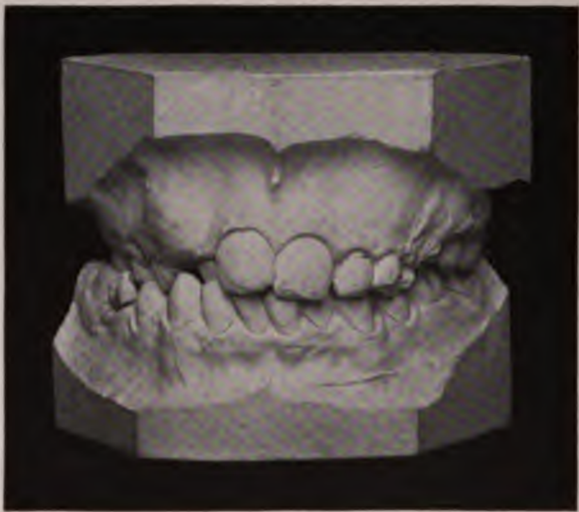


Fig. 31.

Fig. 32.

Figs. 31 and 32.—Normal mesio-distal relation of arches with lingual occlusion of right maxillary molars and premolars (bicuspids) to lowers. Neutroclusion, or Class I, case.

28) with the same lines in Diagram A, Fig. 27. Cases of malocclusion which are mesial or distal on one side only are called unilateral cases. The malrelation of the arches is therefore based on the mesio-distal or antero-posterior relation of the lower to the upper. If both sides of the lower arch are distal to the upper, we speak of it as a bilateral distal occlusion of the lower arch. If one side only of the lower is distal to the normal relation of the upper we call such a case a unilateral distal occlusion of the lower arch. On the other hand, if the lower arch is mesial to the upper arch on both sides, we refer to it as a

Fig. 33.—Abnormal mesio-distal relation of first permanent molars with normal mesio-distal (antero-posterior) relation of arches. Neutroclusion, or Class I, case.

bilateral mesial occlusion. If the lower arch is mesial on one side only it is referred to as a unilateral mesial occlusion of the lower arch.

As a result of this plan of classification, all cases of malocclusion will fall in one of the three groups that have been mentioned, which are based on the mesio-distal relation of the arches. Various efforts have been made to apply some short term to these groups of malocclusion so that it would be simple and easy to designate each case of malocclusion to its proper group. Angle used the numerals, I, II, III, which is a satisfactory way to designate the groups for one who has first learned the characteristics of each group. Better and more descriptive terms have been suggested by Lischer, and adopted by the

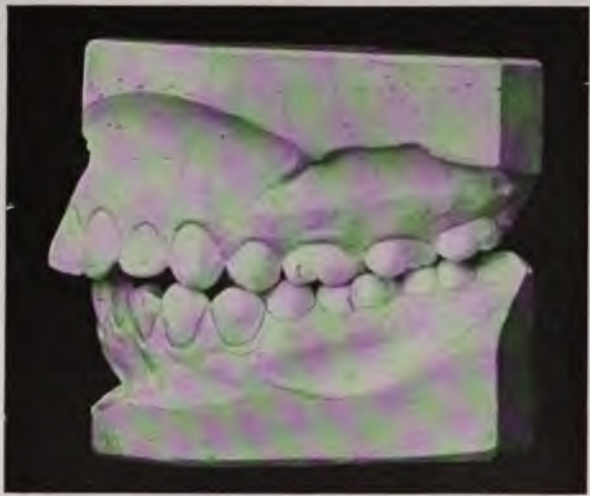


Fig. 34.—Maxillary left second premolar impacted by the drifting of molars mesially, due to early loss of deciduous molar. Arch relations normal mesio-distally (antero-posterior). Neutroclusion, or Class I, case.

Fig. 35.—Showing position of impacted premolar (bicuspid).

American Society of Orthodontists,, which are neutroclusion, distoclusion, and mesioclusion. The relation of the two set of terms is shown below.

ANGLE		LISCHER
Class I	is the same as	*Neutroclusion*
Class II	is the same as	*Distoclusion*
Class III	is the same as	*Mesioclusion*

Believing, from experience with students, that Lischer's terms are more descriptive, the author would suggest their general use; and throughout this work they will be used in conjunction with Angle's numerals.

Fig. 36.—Mutilated case of Neutroclusion, or Class I.

Fig. 37.—Class I, Type 1, case. Neutroclusion with bunched anterior teeth, or Complex Neutroclusion (Lischer).

Neutroclusion, or Class I

Neutroclusion, or Class I, cases are those which present a normal mesio-distal relation of the arches (Figs. 29 and 30). The anterior teeth may occupy any of the seven positions of malocclusion, although the majority of neutroclusion, or Class I, cases show bunching of the anterior teeth. Some of the teeth are in torsi-lingual occlusion, while others may be in labial occlusion. There is usually a narrowing of the upper and lower arches, which would mean that the molars and premolars are in lingual occlusion. The one outstanding feature that is normal, regarding the teeth in this class, is that there must be a normal mesio-distal relation of the arches as indicated by the occlusal

Fig. 38.—Class I, Type 2 case. Normal mesio-distal relation of arches. Protrusion (labial occlusion) of maxillary incisors. Neutroclusion with labioversion of maxillary incisors.

relation of the upper and lower first molars. If all of the teeth are present, it will be equivalent to saying that we have a normal mesio-distal relation of the molars. One or both sides of the molars may be in lingual occlusion, or linguoversion (Figs. 31 and 32). It must also be remembered that a normal mesio-distal relation of the arches does not necessarily imply a normal mesio-distal relation of the molars. Owing to the early loss of the deciduous molar, as shown in Fig. 33, the first permanent molar on the right side has drifted mesially, while all of the other teeth have a normal mesio-distal relation to each other, which shows a normal mesio-distal relation of the arches. Fig. 34 shows

a case of an older patient, also caused by the drifting of the upper molar forward as a result of the loss of the deciduous molar. Fig. 35 shows

Fig. 39.

Fig. 40.

Figs. 39 and 40.—Class I, Type 3 case. Normal mesio-distal relation of arches with linguoversion of maxillary incisors to lowers. Also slight mesial occlusion of mandibular incisors caused by abnormal force of the inclined planes of anterior teeth. Netroclusion with linguoversion of maxillary anterior teeth.

the occlusal view of the case. Again there is a normal relation of the arches, but not of the molars. Therefore, both of these cases (Figs. 33 and 34) are neutroclusion, or Class I, cases.

Neutroclusion, or Class I, Mutilated Cases.—If any of the teeth have been extracted or are missing, we shall often find in these cases a normal mesio-distal relation of arches, and not necessarily a normal mesio-distal relation of the molars and remaining teeth (Fig. 33). In classifying cases where there is a normal mesio-distal relation of the arches and some of the teeth have been lost by extraction, we have to resolve the condition to what it was before the loss of the tooth, whether it is a premature loss of a deciduous tooth or the loss of a permanent tooth. Such cases as have been described above are spoken of and classified as neutroclusion, multilated, or Class I, mutilated (Fig. 36).

Types of Neutroclusion, or Class I.—Neutroclusion presents several different types that demand special mention because they present char-

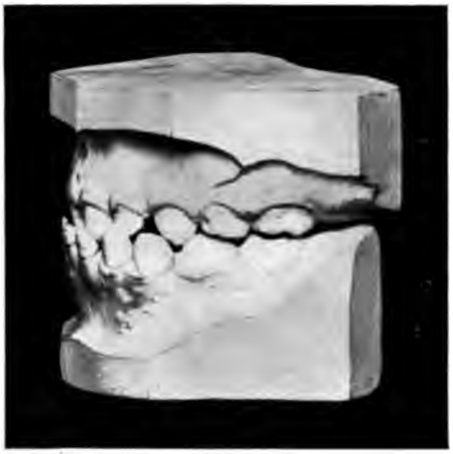


Fig. 41.—Class I, Type 3 case. Neutroclusion with linguoversion of upper anterior teeth.

acteristics that demand special treatment. For convenience we have designated them as Types 1, 2, and 3 of Neutroclusion.

Neutroclusion with Bunched Anterior Teeth, or Class I, Type 1.—These cases are characterized by a normal mesio-distal relation of the arches (Figs. 29 and 30). All of the teeth are in linguoversion or lingual occlusion except that in certain cases we find some or all of the canines in labioversion or labial occlusion (Fig. 37). The upper and lower molars and premolars are in linguoversion or lingual occlusion and demand expansion. The maxillary molars and premolars may be in lingual occlusion to the mandibular molars and premolars on one or both sides.

Fig. 42.—Class II, Division 1 case. Bilaterally distal (posterior) relation of lower arch. Narrow upper arch. Protruding maxillary anterior teeth. Distoclusion with labioversion of maxillary anterior teeth.

Fig. 43.—Class II, Division 1 case. Bilaterally distal relation of lower arch. Bilateral distoclusion with labioversion of maxillary anterior teeth.

There is a condition of the teeth that might be described as "bunched." These cases may be called *complex neutroclusion.*

Neutroclusion with Labioversion of Upper Incisors, or Class I, Type 2.—Cases belonging to this type are characterized by a normal mesio-distal relation of the arches, protruding maxillary anterior teeth (Fig. 38), bunched mandibular anterior teeth and narrow upper and lower arches. The maxillary and mandibular molars and premolars usually occupy the proper bucco-lingual relation to each other. The patient is or has been at some time a mouth-breather, or has a lip-habit.

Fig. 44.

Fig. 45.

Figs. 44 and 45.—Class II, Division 1 case. Malocclusion shown in Fig. 43. Short upper lip, abnormal muscular pressure, mouth-breathing.

Neutroclusion with Linguoversion of Upper Anterior Teeth, or Class I, Type 3.—Here we find a normal mesio-distal relation of the arches (Fig. 39). The maxillary incisors are in linguoversion or lingual occlusion to the mandibular (Fig. 40), with bunching of the maxillary anterior teeth and lack of development in the premaxillary region. The teeth of the mandibular arch may be bunched or occupy a nearly normal approximal relation to each other (Fig. 41). The lower lip appears prominent because the upper lip is underdeveloped as a result of the position of the maxillary teeth.

Any of these types of neutroclusion, or Class I, may be complicated by mutilations.

Fig. 46.

Fig. 47.

Figs. 46 and 47.—Class II, Division 2 case. Bilaterally distal (posterior) relation of lower rch. Retruding or bunched maxillary incisors. Distoclusion with linguoversion of maxillary icisors.

Distoclusion, or Class II

Distoclusion, or Class II, cases of malocclusion are those that are characterized by a distal (posterior) relation of the lower arch. Class II cases are divided into Division 1 (Angle), or distoclusion, with labioversion of the maxillary anterior teeth (Lischer); and Class II Division 2 (Angle), or distoclusion with linguoversion of the maxillary anterior teeth (Lischer).

Distoclusion With Labioversion of Maxillary Incisors, or Class II, Division 1.—Division 1 cases are those that are characterized by a distal relation of the lower arch to the upper, the width of a premolar (Figs. 42 and 43). Instead of the mesio-buccal cusp of the maxillary first molar occupying a mesio distal relation corresponding to the buccal groove of the mandibular first molar, we find it occupying a mesiodistal relation corresponding to the buccal embrasure between the mandibular first molar and mandibular second premolar. The other characteristics of Class II, Division 1, are as follows: A narrow upper arch, protruding anterior teeth, a mandible that is deficient, an underdeveloped or receding chin, abnormal muscular pressure, a short upper lip and mouth breathing (Figs. 44 and 45). Mouth-breathing has disturbed the other forces of occlusion, especially muscular pressure, which has resulted in allowing the maxillary anterior teeth to protrude in the upper arch and in permitting them to remain in an undeveloped condition bucco-lingually. The underdeveloped mandible and the receding chin are the result of the distal occlusion of the mandibular teeth and the abnormal action of the muscles.

Distoclusion With Linguoversion of Upper Anterior Teeth, or Class II, Division 2.—Class II, Division 2 (Figs. 46 and 47) is characterized by the distal relation of the lower arch to the same extent as in Division 1. The other characteristics are directly the opposite. We have an upper arch that is nearly normal in width with retruding and bunched anterior teeth. The mandible is more nearly normally developed and the chin is not receding. We have normal pressure of the lips and cheeks and normal action of the tongue and normal breathing. The difference between Division 1, Class II, and Division 2, Class II, is the result of the difference between normal and abnormal muscular pressure. In order to more clearly enumerate the differences between Division 1 and Division 2, they are given in tabulated form opposite each other in the following table:

Fig. 48.

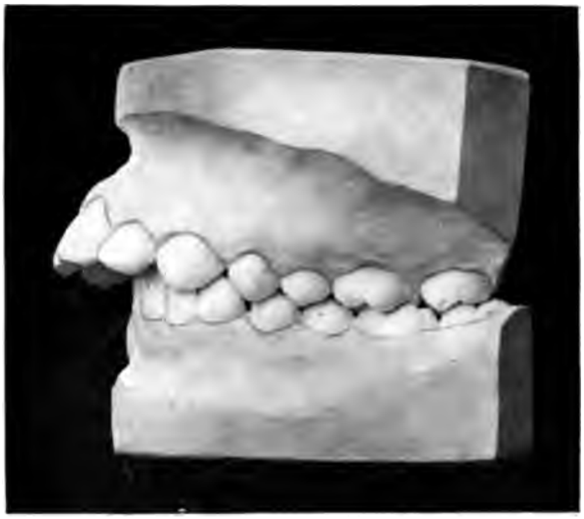


Fig. 49.

Figs. 49 and 50.—Class II, Division 1, Subdivision. Unilaterally distal (posterior) relation of lower arch (left side of lower, distal; right side, normal). Protruding superior anterior teeth. Unilateral distoclusion with labioversion of maxillary anterior teeth.

Class II

DIVISION 1.	DIVISION 2.
Bilaterally distal relation of the lower arch.	Bilaterally distal relation of the lower arch.
Protruding anterior maxillary teeth.	Retruding and bunched maxillary anterior teeth.
Narrow upper arch.	Upper arch nearly normal in width.
Undersized chin.	Normal-sized chin.
Undersized mandible.	Normal-sized mandible.
Abnormal muscular pressure.	Normal muscular pressure.
Abnormal atmospheric pressure.	Normal atmospheric pressure.
Mouth-breathing.	Normal breathing.
Subdivision of Class II, Division I.	Subdivision of Class II, Division 2.
Unilaterally distal with the same characteristics as Division 1.	Unilaterally distal with the same characteristics as Division 2.
One side of the lower arch is in normal mesio-distal relation to the upper.	One side of the arch is in normal mesio-distal relation to the upper.

Both Division 1 and Division 2 of Class II sometimes show a distal relation of the lower arch present on one side only. It may be on either the right or the left side according as the etiological factors have been present. These cases of Division 1 and Division 2 are therefore called subdivisions, or unilateral distoclusions, and are named as Class II, Division 1, Subdivision; or Class II, Division 2, Subdivision; or just reversing them and saying Subdivision of Division 1 of Class II, or Subdivision of Division 2 of Class II. These subdivisions are spoken of as being unilaterally distal. The other characteristics are exactly the same as found in Division 1 and Division 2 (as shown in table). For example, a subdivision of Division 1, Class II (Figs. 48 and 49) would be a case in which we had a normal mesio-distal relation of the arches on one side, with a distal relation of the lower arch on the other, a narrow upper arch, protruding anterior teeth, an underdeveloped mandible, a receding chin, abnormal muscular pressure and abnormal breathing. A subdivision of Division 2 of Class II (Figs. 50 and 51) would be a case in which the lower arch was distal on one side, on the other side normal mesio-distally, an upper arch nearly normal in width, retruding and bunched maxillary incisors, a mandible of nearly normal size, a normal chin, normal muscular pressure, normal atmospheric pressure and normal breathing. It does not matter, so far as the classification is concerned, whether the right or left side in these subdivision cases is normal or abnormal mesio-distally (Figs. 52 and 53).

Fig. 50.

Fig. 51.

Figs. 50 and 51.—Class II, Division 2, Subdivision. Unilaterally distal relation of lower arch. Right side, normal; left side, distal. Bunched superior anterior teeth. Unilateral distoclusion with linguoversion of maxillary incisors.

Fig. 52.

Fig. 53.

Figs. 52 and 53.—Class II, Division 2, Subdivision. Unilaterally distal relation of lower arch. Left side normal; right side, distal. Normal lip pressure is bunching anterior teeth. Unilateral distoclusion with bunching maxillary anterior teeth.

Mesioclusion, or Class III

Mesioclusion, or Class III, cases are those that are characterized by the mesial relation of the lower arch to the upper arch the width of one premolar (Fig. 54). The mesio-buccal cusp of the maxillary first molar occupies a mesio-distal relation which corresponds to the buccal embrasure between the mandibular first and second molars.

Class III presents a division and subdivision, which is a bilateral mesioclusion and a unilateral mesioclusion, and also three types.

Class III, Type 1.—These cases present a mesial relation of the lower arch to the upper (Figs. 55 and 56). The teeth in each arch present an even alignment, with practically no torsiversion in either

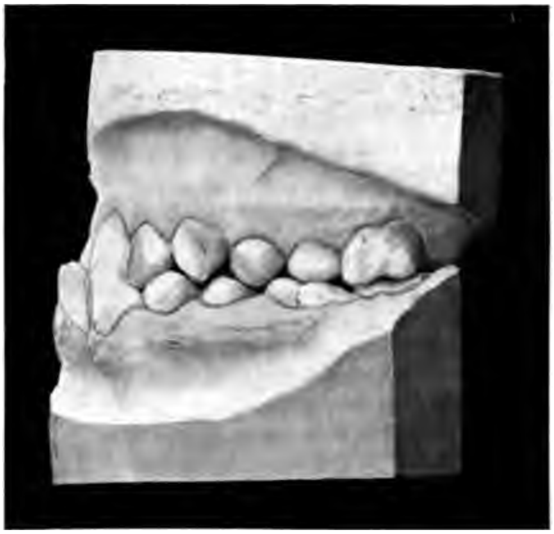


Fig. 54.—Class III. Mesial (anterior) relation of lower arch. Mesioclusion.

arch. Each dental arch is very nearly the correct shape, and if viewed separately from the occlusal view, the true condition of the malocclusion would not suggest itself (Figs. 57 and 58). There is an appearance of the lower arch having moved forward from a normal occlusion to one that is mesial. The lip pressure is normal and we have normal breathing.

Class III, Type 2.—The lower arch is mesial to the upper the width of one premolar. The maxillary teeth are in good alignment with little torsiversion (Figs. 59 and 60). The mandibular incisors are bunched and in lingual relation to the upper. The patient is a normal breather

[redacted] type presents less facial deformity than
[redacted]ss III, or mesioclusion, because the man-

Fig. 55.

Fig. 56.

[redacted]Bilaterally mesial (anterior) relation of lower arch with
[redacted]llary and mandibular teeth. Bilateral mesioclusion.

[redacted]nched and there is little overdevelopment

Class III, Type 3.—The lower arch is mesial to the upper the width of one premolar (Fig. 61). The upper arch is underdeveloped and the anterior teeth bunched and in lingual occlusion to the lower. The mandibular teeth are in fairly good alignment.

Fig. 57.

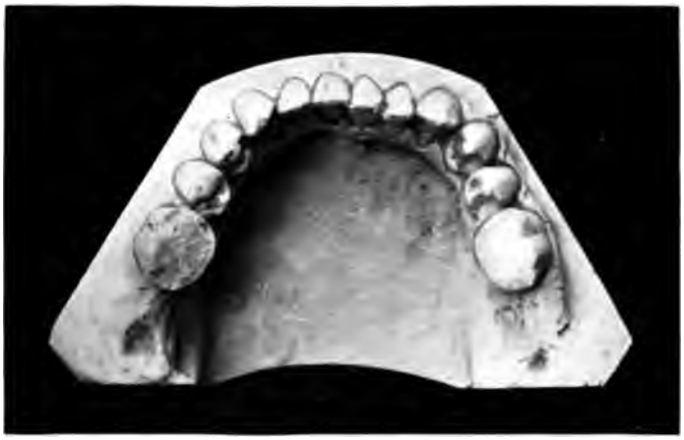


Fig. 58.

Figs 57 and 58.—Class III, Type 1. Showing even alignment of teeth in each arch. Bilateral mesioclusion with even alignment of the teeth.

The facial deformity is very marked in these cases owing to the overdevelopment of the mandible and the underdeveloped premaxillæ.

Unilateral Mesioclusion, or Class III, Subdivision.—These cases are characterized by a mesial relation of the arch on one side and a normal

Fig. 59.

Fig. 60.

Figs. 59 and 60.—Class III, Type 2. Bilaterally mesial relation of lower arch. Bilateral mesio-clusion with bunched mandibular anterior teeth.

relation, mesio-distal on the other (Figs. 62, 63 and 64). The positions of the anterior teeth may resemble any of the types described under the division. Owing to one side of the arch being in normal mesio-distal relation and the other in mesial relation, there is a tendency for a

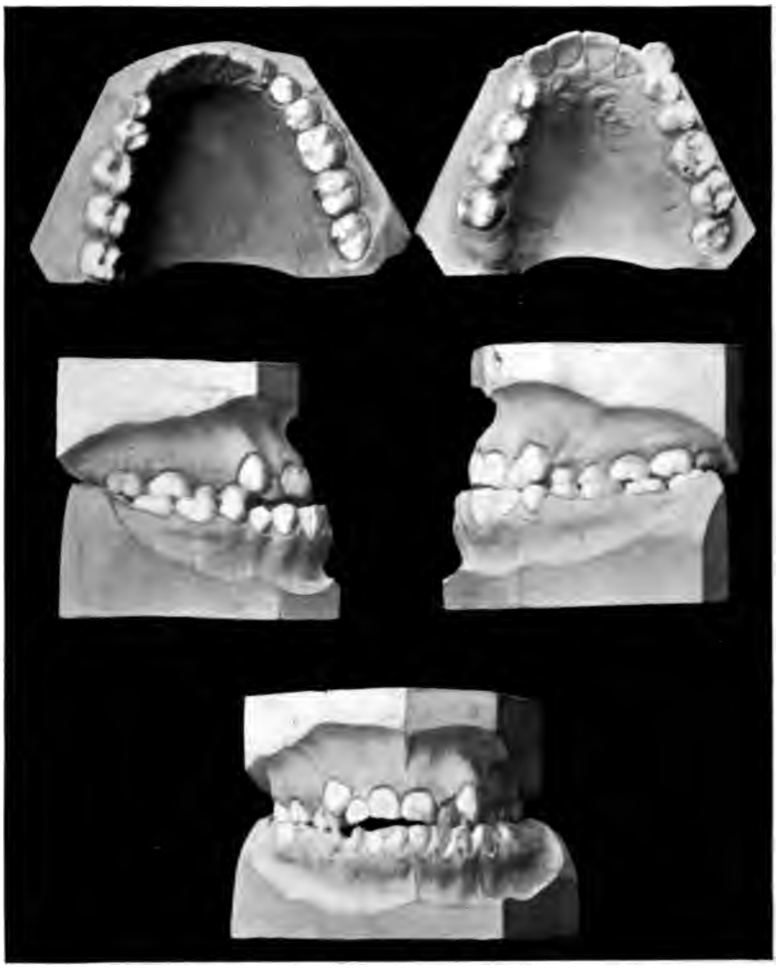


Fig. 61.—Class III, Type 3. Bilaterally mesial relation of lower arch. Bunched maxillary anterior teeth. Small upper arch. Mandibular teeth in fair alignment. Bilateral mesioclusion with bunched maxillary anterior teeth.

cross-bite to be present in the region of the incisors, which produces a great amount of abrasion of the incisal edge of those teeth. Subdivision cases of Class III also cause an abnormal relation in the median line of the upper and lower arches.

Fig. 62.

Fig. 63.

62 and 63.—Class III, Subdivision. Unilaterally mesial relation of lower arch. Right side, normal; left side, mesial, unilateral mesioclusion.

Unilateral Mesioclusion and Distoclusion.—There are some cases that are mesial on one side and distal on the other. This type of cases has been incorrectly called "Class IV." The case shown (Figs. 65 and 66) is of that type. The etiologic factors are not understood in regard to these conditions. After a careful examination of this case, the author is convinced that the trouble was entirely with the relation of the teeth and not with the relation of the condyle to the glenoid fossa. There may be some patients in whom the mandible may be overdeveloped on one side, or the condyle may occupy an anterior relation to the glenoid fossa on one side; but it is more probable that the deformity is in the arches and not in the mandible.

Fig. 64.—Front view of Class III, Subdivision, or unilateral mesioclusion.

Malformation of the Jaws and Their Processes, and Abnormal Relation of the Mandible to the Maxillæ

In the study of malocclusions, we find some conditions that can be accurately described only by taking into consideration the relation of the mandible to the face and cranium. We then speak of those conditions as "malposition of the mandible." Some of these conditions include an entire malposition of the mandible as shown by the relation of the glenoid fossa to the condyle. Others may be a relative condition only, which may be complicated by lack of development in the body of the mandible that gives the appearance of a misplaced mandible. In those cases where we find an anterior position of mandible, Federspiel

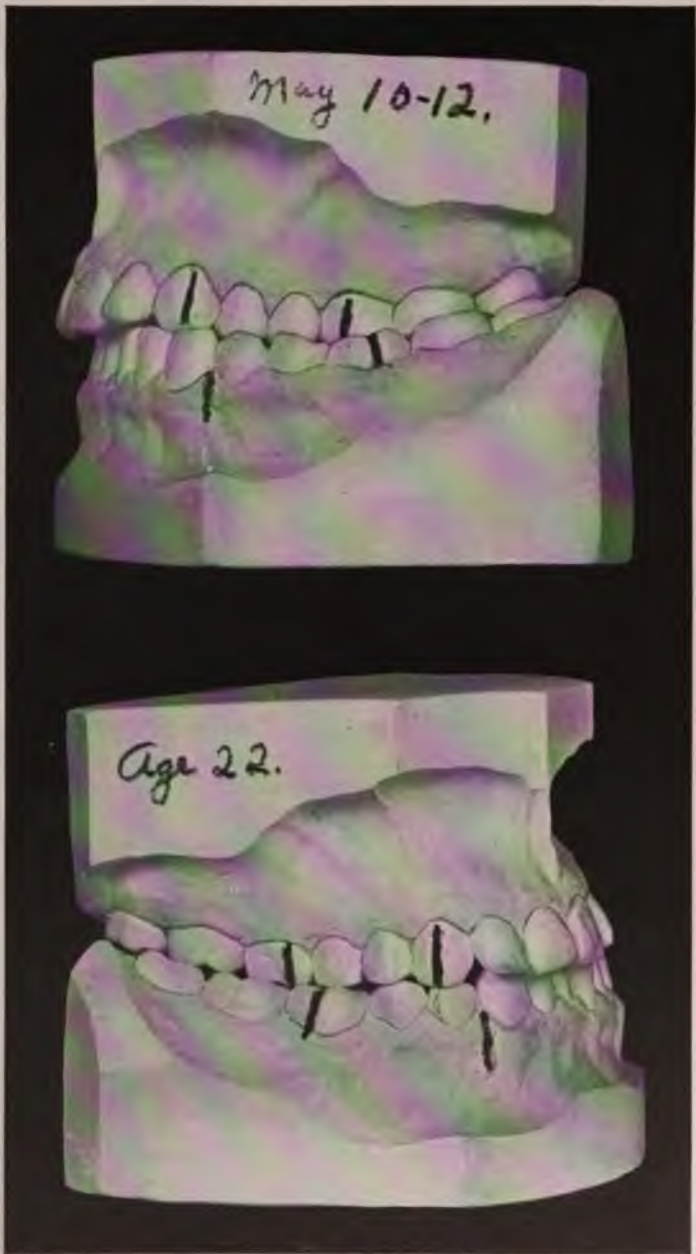


Fig. 65.—Unilaterally mesial and distal relation of lower. Incorrectly called Class IV. Unilateral mesioclusion and distoclusion.

has suggested the term *mandibular anteversion.* He has also suggested the term *mandibular retroversion* for those cases in which the mandible is distal. Figs. 67 and 68 show a case taken from Lischer's practice which he describes as mandibular retroversion of which the disto-

Fig. 66.—Occlusal view of case, with lower arch unilaterally mesial and distal.

clusion is only a symptom. There are cases on record that show a mesial relation of condyle to the glenoid fossa.

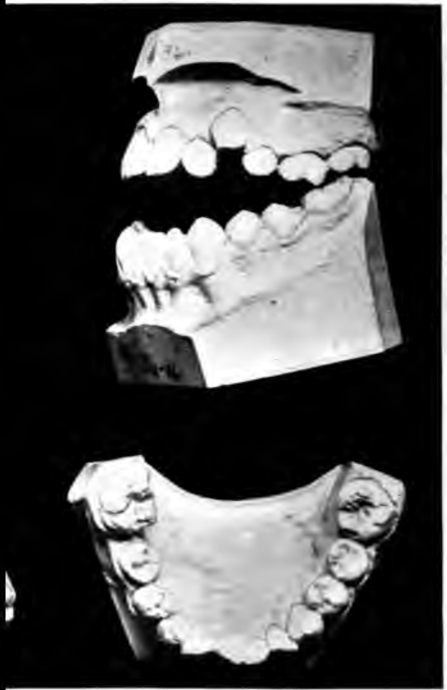
In considering the malformations of the mandible and the maxilla, it is hard to determine which is the cause and which is the effect. Cer-

Fig. 67.—Mandibular retroversion. The bilateral distoclusion is merely a symptom. (Lischer.)

Fig. 68.—Profile of case shown in Fig. 67. (Lischer.)

Fig. 69.—Right side of skull with mesioclusion, or Class III; also showing a malformation of the mandible.

Fig. 70.—Left side of skull with mesioclusion and malformation of the mandible.



[redacted]ular curvature. (Lischer.)

[redacted]ase shown in Fig. 71. (Lischer.)

Fig. 73-A.—Macromandibular development. Note the symmetrical, well-developed upper arch; the bilateral mesioclusion is merely a symptom of the lower jaw deformity. (Lischer.)

Fig. 73-B.—Profile of case shown in Fig. 73-A. The mandible is too long and its angle too obtuse. (Lischer.)

tain types of malocclusion will produce an overdevelopment or an underdevelopment of the mandible, while certain others will have a similar effect on the maxilla. However, in considering these facial deformities, we are compelled to recognize the malformation of the parts. The close relation existing between the malposition of the arches and the malformation of the jaws is shown in Figs. 69 and 70. It will be observed in this case that the position of the condyle is normal, as nearly as it is possible to determine. A greater malformation of the mandible in a case reported by Lischer is shown in Figs. 71 and 72. This condition he has termed *mandible curvature*.

Deformities of the jaws may present themselves as developments, for which the terms *macro-* and *micro-* serve admirably. If it is an overdevelopment of the mandible it is called *macromandibular*. Such a case is shown in Figs. 72 and 73. The teeth are in mesioclusion with little torsiversion of either the upper or the lower. The profile shows the overdevelopment of the mandible very plainly. We also find cases in which the mandible is underdeveloped, which is described as micromandibular development. Figs. 74 and 75 show such a condition.

An overdevelopment of the maxillæ is termed *macromaxillary* development, while an underdeveloped maxillæ is a *micromaxillary* development. An extreme case of underdevelopment of the maxillæ and therefore micromaxillary development is shown in Figs. 76 and 77.

In considering the malrelations of the jaws and the maldevelopment of the body of the mandible, the maxillæ, and their processes, we must be careful not to confuse one with the other. An overdevelopment of the mandible might be mistaken for a mandibular anteversion. The author is of the opinion that the cases shown in Figs. 69, 70, 72, and 73 are abnormal developments of the mandible and not mesial positions of the condyle. Care must also be observed in studying cases that present an underdevelopment of the mandible, so as not to confuse them with retroversion of the mandible which is quite a rare condition. Fig. 78 shows a case of distoclusion with underdevelopment of the mandible in which the condyle occupies a normal relation to the glenoid fossa and is therefore not a case of retroversion of the mandible.

In the study of the mesial and distal relations of the lower arch, we must use every means at our command to prove that so-called distoclusions are not mesial occlusions of some of the upper teeth. Figs. 33 and 34 show cases in which the upper molars have drifted forward. By observing the malrelation of the approximating teeth and the arch relations as shown by the teeth that are in normal position, a correct diagnosis can be made. However, in some cases a correct diagnosis of

Fig. 74.—Micromandibular development. Note the torso-linguoversion of the maxillary lateral incisors, encroaching on the cuspid spaces. The maxillary incisors are not in labioversion. (Lischer.)

Fig. 75.—Profile of case shown in Fig. 74. The mandible is too short in body and rami. (Lischer.)

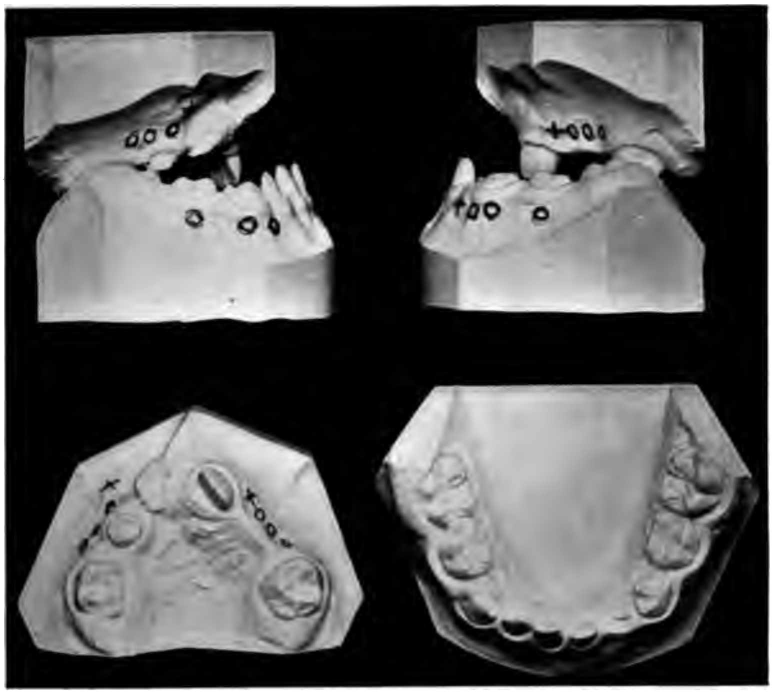


Fig. 76.– Micromaxillary development. Note the marked arrest of development, complicated by deficiency in the number of teeth. (Lischer.)

Fig. 77. Profile of case shown in Fig. 76. (Lischer.)

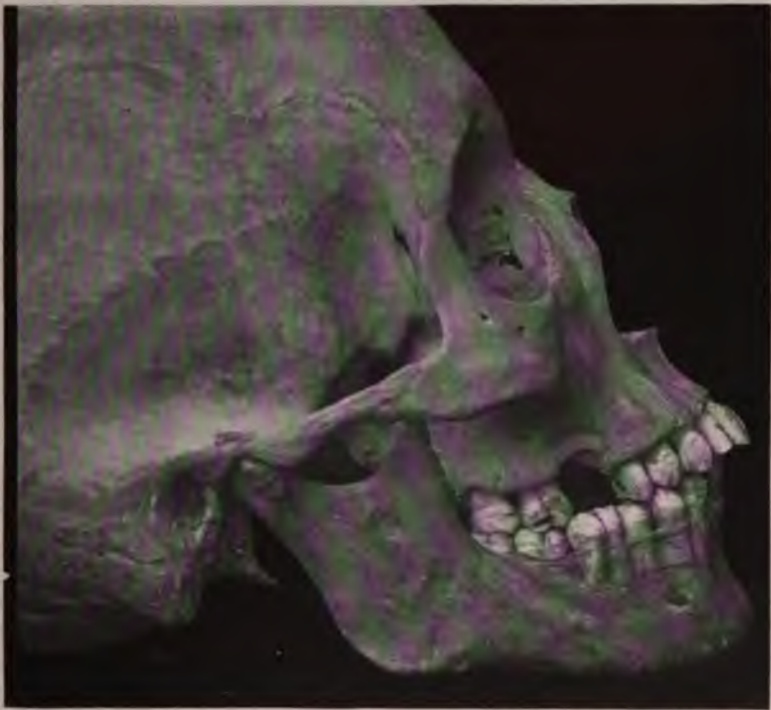


Fig. 78.—"Class II skull." Lower arch distal. Distoclusion.

Fig. 79.

Fig. 80.

Figs. 79 and 80.—Skull showing normal mesio-distal relation of arches. Right side shown in Fig. 80. Left side of skull shown in Fig. 79, showing what appears to be distoclusion but is a mesial relation of the upper teeth. (Hellman.)

Fig. 81.—Occlusal view of skull shown in Figs. 78 and 79. (Hellman.)

Fig. 82.—Normal skull.

the conditions is more difficult. Fig. 79 is the left side of a skull that presents a normal mesio-distal relation of the arches. The occlusion appears to have been practically normal before the teeth were lost. The condyle appears in the normal position and the mandible is also normal. Fig. 80, the right side of the same skull, shows what may be called a

distoclusion or a distal relation of the lower arch on the right side. However, in examining the occlusional view of the skull (Fig. 81), it will be observed that the upper teeth on the right side occupy an anterior position in the skull as compared with those on the left side. By comparing the relation of the first molars to the bases of the zygomatic arches, the difference in the relation of the two sides can be seen. Just what would cause this abnormal development, we have no way of determining at the present time in this case.

In examining a large number of skulls, the author has found none that shows a distal relation of the condyle, although this condition may exist. In considering the positions of the condyle, it is well to remember the relation that exists between the shape of the teeth and the shape of the condyle and glenoid fossa. As a result of malocclusion and of the movements of the mandible, the shape of the condyle will change, but the change in shape will always be in keeping with the occlusion and be limited by the ligaments that form the temporomandibular articulation. In studying the malpositions of the mandible, the anatomy of the parts must be kept in mind and the normal relation of the condyle as shown in Fig. 82.

In considering the classification of malocclusions in the order of their frequency, we find that malpositions of the teeth are first in number, then we find malrelations of the arches, third, malformations of the jaws and processes, and last in number and frequency of occurrence, malpositions of the mandible.

Malocclusion and Facial Deformities

The close relation between malocclusion and the development of the face must always be considered in the classification. In fact, we may state that there is an equally important relation existing between normal occlusion and normal development of the face. Various writers have agreed that the teeth play a greater part in the production of beauty in the face than any other organs or parts of the face. It would be very difficult to conceive of a really ugly face if the teeth were in normal occlusion, or of a really beautiful face if the teeth were in decided positions of malocclusion. However, there are a great many factors that enter into the development of the face, and it is very difficult to make a set and fast rule by which to judge either facial deformity or facial beauty.

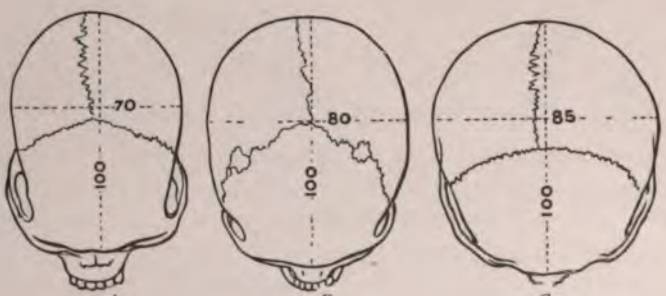
We must recognize in the beginning the relation that the head forms will have on the facial outlines of the patients, as well as the influence

that age will have on the development of the facial profile. The various changes that occur in the mandible as the individual grows older, and which are shown in textbooks as being the result of age, are familiar to all. The evolution of the profile is illustrated in Fig. 83.

The principal changes that are observed from infancy to old age are the result of changes occurring in the dentition. In the child, we

A *B* *C*

Fig. 83.—Evolution of the Profile. (A) Infancy; (B) Maturity; (C) Senility. (Lischer.)



A *B* *C*

Fig. 84.—Cephalic Index. (*A*) Negro, index, 70, dolichocephalic; (*B*) European, Index, 80, mesocephalic; (*C*) Samoyed, index 85, brachycephalic. (Lischer, after Tyler.)

find the lower part of the face short until the teeth begin to erupt and then we notice the increase in length that is observed in the adult. With the loss of the teeth, the face again shortens and we find the characteristics of old age.

The shape of the face will also be influenced to a certain extent by the shape of the cranium and the cranium can be classified according

to a plan used by anthropologists. The cephalic index is employed, which is the relation of the length of the cranium from forehead to the back as compared with the width on the head between the ears. The length is made to represent 100, and the breadth is made to represent a fraction of that measurement. When the head is broad there will be a tendency for the cranium to become more rounded, and as a rule the face will also be more rounded than in the narrow cranium. The cranium is classified, according to the cephalic index, when the breadth across the cranium from the ears is more than eighty per cent of the length as the brachycephalic; when the breadth is less than seventy-five per cent of the length it is classed as dolychocephalic; and when the breadth is between seventy-five and eighty per cent of the length, it is termed mesocephalic (Fig. 84).

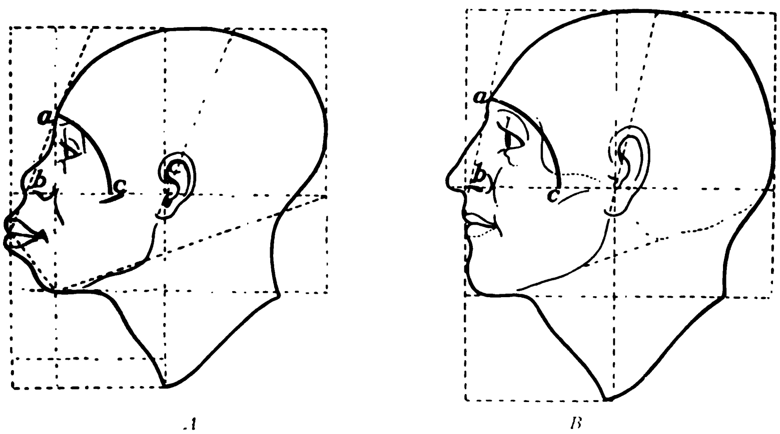


Fig. 85.—Facial Index. (*A*) Negro; (*B*) Caucasian. (Lischer, after Camper.)

Racial characteristics are also seen in the study of the facial profile, and the various facial angles as found in different races are shown in Fig. 85, which is made after the Dutch anatomist, Camper. By studying *A* in Fig. 85 it will be seen that the angle of the mouth and nose diverges away from a straight line, while *B* approaches the straight line.

The projection of the teeth and the lower part of the face is also influenced by the race, and the amount of that protrusion can be studied by the *gnathic index*. The three distinct variations of facial protrusion or projection of the teeth and the lower part of the face are represented in Fig. 86. Fig. 86*A* shows a skull with a great protrusion of the teeth, and is therefore termed *prognathic;* Fig. 86*B* shows one with less protrusion but still far from a straight line, and is termed *mesognathic;*

while Fig. 86C shows a face that closely approaches the straight lines, and is therefore termed *orthognathic*. It must be remembered that race will influence the various facial angles, and malocclusion may cause facial deformities that will resemble the various conditions that have been mentioned.

The racial characteristics that can be clearly seen in the various races can also be followed to a lesser extent in the different nations. It is a well-known fact that people of different localities have facial developments that distinguish them from people of other localities. Fig. 87 shows various head and face forms as found in some of the nations of Europe. Fig. 88 represents the different facial characteristics as found

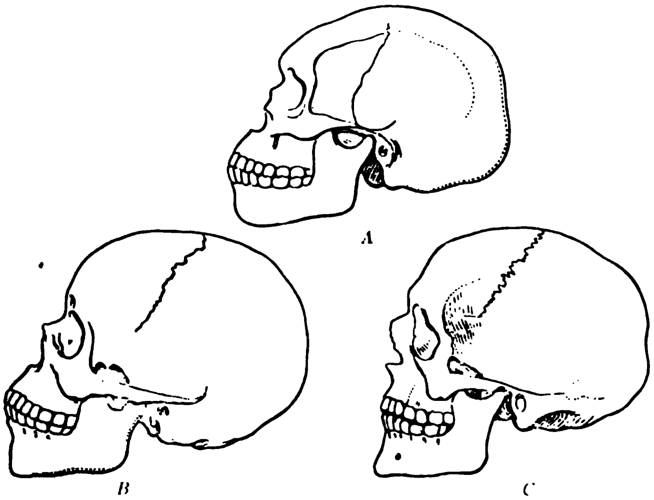


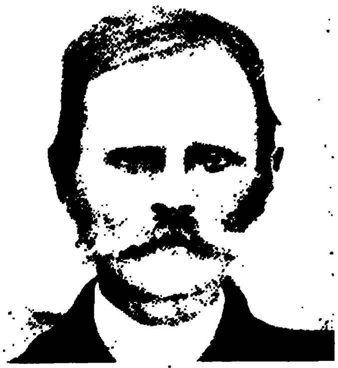
Fig. 86.—Gnathic Index. (*A*) Prognathic; (*B*) Mesognathic; (*C*) Orthognathic. (Lischer, after Flower.)

in some of the blond and brunette races. Owing to the mixing of races we find the various racial characteristics blended together so that it will not always be easy to pick out the pure types. This blending of races and nations often produces types that do not resemble either of the parents. Consequently it becomes necessary to study each face as a law unto itself, and in order to do so it is imperative that we have some idea of what constitutes the normal. In the first place, it is very difficult to define a beautiful face, as beauty is to a certain extent a question of education. What one person would consider beautiful would not be so considered by others, and this is equally true in the study of facial forms. However, there are certain anatomic factors that enter into the

Swiss, Basle. Index 64.

Norwegian, Aamot. Index 75.

German, Baden. Index 83.



Hungarian, Theiss. Index 88.5.

Lapp, Scandinavia. Index 94.

French, Savoy. Index [illegible].

Fig. 87.—Illustrating the relation between face form and head-form. (Lischer, after Ripley.)

Teutonic type (Norway). Pure blond.

Alpine type (Austria). Blue eyes, brown hair. Index 88.

Mediterranean type (Palermo, Sicily). Pure brunet. Index 77.

Fig. 88. The three European racial types. (Lischer, after Ripley.)

human face which must be considered and which go toward the formation of a pleasing whole. In studying a face, we should do so from at least two views, the front and the profile. In some instances we find faces that present a pleasing outline if viewed from the front, but when viewed from the side, some part is out of harmony with some other part. This is often true in the study of conditions associated with malocclusion of the teeth.

The principal parts of the face are shown in Fig. 89. The mento-

Fig. 89.—Principal features in the face, the relations of which may be altered by orthodontic treatment. Front view. (*a*) Mentolabial sulcus, (*b*) angle (angulus oris), (*c*) upper lip, (*d*) cheek (bucca), (*e*) nasolabial sulcus, (*f*) tip (apex nasi), (*g*) base (basis nasi), (*h*) frontal eminence, (*i*) root radix nasi, (*j*) dorsum (dorsum nasi), (*k*) ala (ala nasi), (*l*) nostril (nares), (*m*) philtrum, (*n*) aperture (rima oris), (*o*) lower lip, (*p*) chin (mentum). (Lischer.)

labial sulcus (*a*) is located between the lower lip and the chin. The development of this sulcus is greatly influenced by the position of the roots of the lower teeth. The angle of the mouth, angulus oris (*a*), is influenced by the position of the anterior teeth and also by the width of the arch in the canine region. In cases of malocclusion where the arches are narrow and the canines in lingual occlusion, the angles of the mouth will be close together and the lips more or less wrinkled. The angles of

the mouth will also be greatly influenced by breathing, depending upon whether the patient is a normal breather or a mouth-breather. The position and development of the upper lip (*c*) depends upon the teeth and breathing. There are certain lip habits that will produce malocclusions, and the action of the lip itself may produce its overdevelopment, which will cause an unpleasing expression of the face. The upper lip of mouth-breathers is very short and thin, owing to the lack of use that it receives

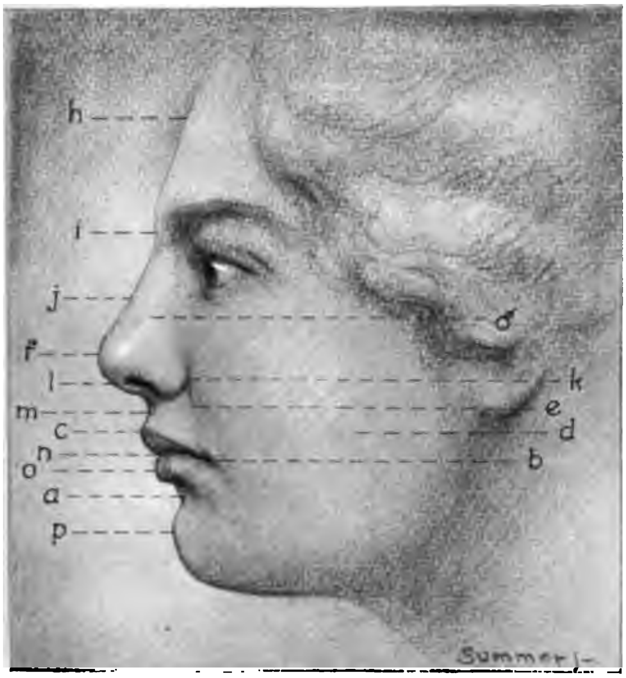


Fig. 90.—Principal features of the face. Side view. (*a*) Mentolabial sulcus, (*b*) angle (angulus oris), (*c*) upper lip, (*d*) cheek (bucca), (*e*) nasolabial sulcus, (*f*) tip (apex nasi), (*g*) base (basis nasi), (*h*) frontal eminence, (*i*) root (radix nasi), (*k*) ala (ala nasi), (*l*) nostril (nares), (*m*) philtrum, (*n*) aperture (rima oris), (*o*) lower lip, (*p*) chin (mentum). (Lischer.)

in such individuals. The cheek, bucca (*d*), may be influenced by the amount of fat present and exerts some pressure on the teeth, in turn counteracted by the tongue. In a few cases the author has seen the cheek so full of adipose tissue that it would exert sufficient pressure on the teeth to narrow the dental arches. The naso-labial sulcus (*e*) is formed by the junction of the cheek, the lip, and the nose. The development of this region will be changed by the abnormal development of any of the parts mentioned. The canine tooth also takes part in the development of

the naso-labial sulcus, and in individuals who have lost the canine the sulcus becomes more noticeable.

The development of the tip of the nose (apex nasi) depends upon the normal development of the nasal septum and premaxillary bones, as well as of the nasal cartilages. The tip of the nose will also be influenced by mouth-breathing, and it is exposed to all kinds of injuries resulting from physical violence, it may be displaced and thus may have an unpleasing effect on the rest of the face. The base of the nose (*g*) depends upon nasal breathing for its proper development. In mouth-breathers the base of the nose remains narrow, the skin is tightly drawn, and we have a very unpleasing appearance. The frontal eminence is a very noticeable

Fig. 91.—Facial cast of boy nine years of age, with normal occlusion. (Parsons.)

part of the face but is not influenced by the teeth. It may, however, be taken as an indication as to what the development of the face should have been in those patients who have decided malformations of the teeth and jaws. The root of the nose (*i*), located at the base of the frontal bone, depends for its development upon normal breathing, and also upon the proper development of the frontal sinus with which it is closely associated. The dorsum of the nose (*j*) may present a variety of shapes, ranging from pug to Roman, and may also be influenced by racial characteristics. Like the tip of the nose, it is subject to injury, which may change its shape. Abnormal developments that influence the development of the septum will also play some part in shaping the dorsum of the

nose. The ala nasi, or ala, of the nose (*k*) is largely influenced by environment. In persons who have been mouth-breathers we find that the ala is not developed normally, and it remains thin and flabby. This thinness and flabbiness of the ala has been thought by some to be a contributing factor toward continued mouth-breathing, owing to the fact that the ala is not sufficiently developed to prevent the atmospheric pressure from shutting off the nasal tract. In normal breathers the ala is well developed and gives a strong expression to the face. The nostril (*l*) depends upon the development of the surrounding parts for its shape. The philtrum (*m*) plays a great part in the beauty of the face and is dependent upon the position of the teeth for its shape. The development of the nose, the development of the lips, and in fact the development of all of the parts around the oral cavity will influence the philtrum. The aperture of the mouth (*n*) will be of a size and shape in keeping with the

Fig. 92.—Models showing the occlusion of the teeth of Fig. 91. (Parsons.)

lips. In some individuals we find an aperture that is quite small and the dental arches large, while in others the reverse may be true. The lower lip (*o*) is a great factor in the beauty of the face. No part of the face adds so much to the expression as do the lips, and the lower lip is equally as important as the upper. In fact, in some respects the lower lip is more of a factor in producing malocclusion of the teeth than is the upper. In lip habits, we find that the lower lip is the one that does the most harm. Mouth-breathers, as a rule, have thick lower lips, which are held between the lower and the upper anterior teeth, with the result that the maxillary anterior teeth are forced outward. In mesioclusion cases, the lower lips play a great part in forcing the mandibular incisors lingually if the patient is a normal breather. The lower lip covers the mandibular anterior teeth and overlaps the incisal third of the maxillary incisors,

therefore exerting a direct pressure on the labial surfaces of the upper teeth in the normal breather. The chin (*p*) has long been recognized as an important factor in the development of the face, and people have been classified according to the development of the chin as having strong or weak characters. As the chin is the anterior part of the mandible it will be more or less affected by everything that affects the mandible. In cases of distoclusion with mouth-breathing, the chin is greatly underdeveloped, while in cases of mesioclusion the chin will be overdeveloped. In unilateral cases of malocclusion, in cases in which there is an unequal development of the two sides of the mandible, we find that the chin may be deflected to one side or the other. In cases of neutroclusion, charac-

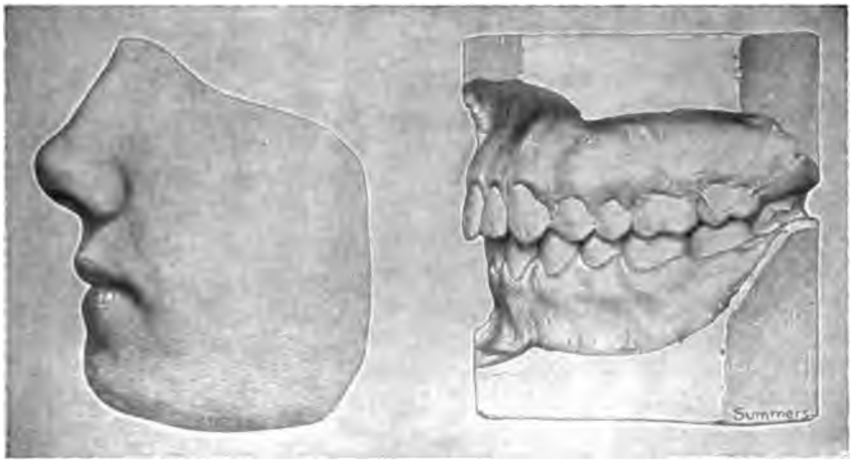


Fig. 93.—Normal type of face with normal occlusion. (Lischer.)

terized by underdevelopment of the dental arch, the chin will suffer in development because the mandible will be small.

Fig. 90 shows a profile of the face with the same anatomical markings as are found in the front view of Fig. 89. This profile, as well as the front view, probably gives the artist's conception of what he considers a normal face should be. The two views also show the necessity of having both a front and a side view of each patient. The front view is a very good face and shows each of the parts normally developed. Some might object to the size of the mouth, but from an anatomic standpoint the author considers that the mouth is of the proper size and that the face is nearly normal. The profile view, from an anatomic standpoint, is not as good, as the lower part of the face is too weak. The mandible, the chin, and the lower lip are too receding for a face that has a normal

set of teeth, and if the teeth are receiving proper use, and the subject has normal breathing. However, Fig. 90 only shows how difficult it is to select a definite type of beauty or of face to please everyone.

It is equally as difficult to decide just what the normal face is, for we have shown that racial characteristics enter into the question to such an extent that we are unable to choose a standard type. It is conceded that the best balanced faces are those that have all of the teeth present and the teeth in normal occlusion. However, in examining people with normal occlusions we find that the faces differ in varying degrees and that all are not equally beautiful.

What might be considered beautiful by one person would not be so considered by another. The African negro is probably considered beau-

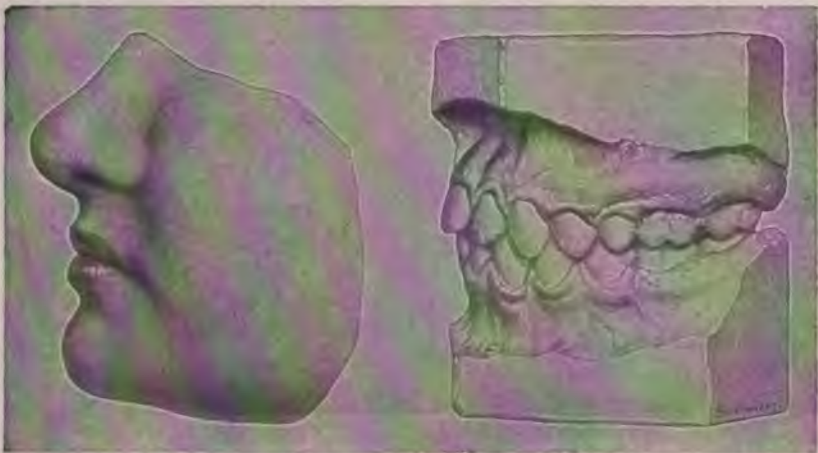


Fig. 94.—Prominent chin, with normal denture. (Lischer.)

tiful among his own people, but he would not satisfy the sense of the beautiful in the European. Also certain developments that are in harmony in one face would be out of harmony in another. Some faces are in balance with pug noses, other faces look well with Roman noses, but to reverse the noses on the respective faces would be to create very unpleasing facial expressions.

In order to arrive at any conception of what a face should be, it is necessary to study a large number of faces of various types. Fig. 91 shows the facial cast of a boy of nine, which may be considered to be nearly normal. The forehead, the nose, the lips, and the chin, all show that the boy is a normal breather and in order to have the development of the face that he has, he must possess a nearly normal occlusion of the

teeth. The occlusion of the teeth is shown in Fig. 92. In comparing this face with the one shown in Fig. 90, the author prefers the face of the boy to the artist's conception, since his idea of a normal face is based on the anatomic parts that as a whole go to make up the face. Some of us might claim that the mouth and lower part of the face in Fig. 91 is too heavy, but it must be remembered that a boy at the age of nine has his permanent incisors, that the arches should be wide, and that the mouth should be full.

Angle has stated that the best harmony and the best balance of the face will be found in those individuals who have normal occlusion of the teeth. The author believes this to be true, but it does not prove that all individuals with normal occlusions will look alike. Fig. 93

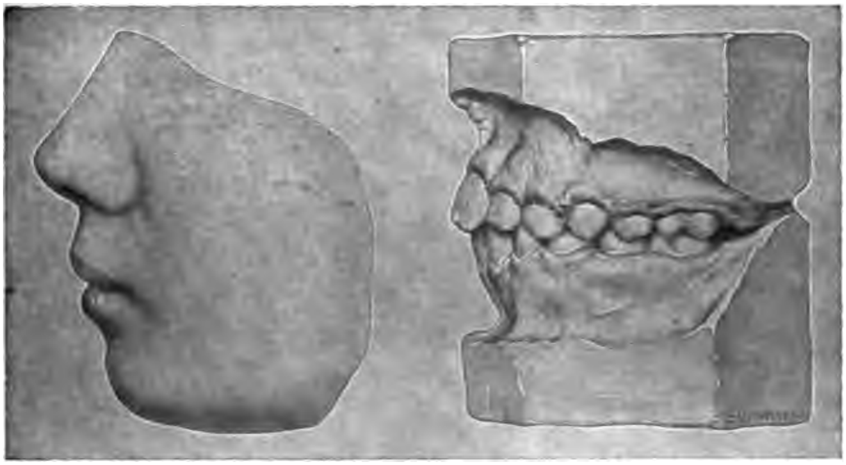


Fig. 93. Receding chin, with normal denture. (Lischer.)

shows another type of face that has normal occlusion of the teeth. It will be observed that this type of face closely approaches the type shown in Fig. 91.

Fig. 94 shows a type of face that possesses a prominent chin and normal occlusion of the teeth. The development of the chin and mandible in this type of face is, in the author's opinion, the result of use. We find this type of chin in individuals who are public speakers, actors, lawyers, and others who have used the muscles of speech to a great extent. In fact, it has been said by anatomists that the development of the chin in man has been the result of speech. The observation of the author is in keeping with this statement, and the type of face shown in Fig. 94 is such as is found in those who are normal breathers and also

public speakers. It would be impossible to have the development of the chin to the extent as shown in an individual who is a mouth-breather. The use of the teeth as organs of mastication has also played a part in the formation of the face shown in Fig. 94.

Fig. 95 illustrates the type of face with a receding or weak chin, but which has a normal occlusion. With these individuals, the teeth are in normal positions but the functions of the teeth have been neglected to such an extent that the supporting structures have never developed. These patients are normal breathers, and the maxillæ have developed

A. *B.*

Fig. 96.—Photographs of 12 year old patient before treatment. (Tanzey.)

enough so that normal breathing is possible. The mandible and chin have not developed because of the lack of use in mastication, and the muscles of speech have also been inactive. People of this type are not forcible speakers, for if they were the chin would develop to the proper size. The lack of proper development is seen in the mento-labial sulcus and the mental eminence. The normal occlusion of the teeth and the normal respiration give the upper and lower lip a good expression, but the weakness is in the mandible and chin.

In studying facial development associated with malocclusion, we find

that certain types of malocclusion always give certain types of facial deformity. With a certain malocclusion, there is always a certain action of the muscles, a certain manner of breathing and a certain action of the teeth in mastication, so that the facial development associated with malocclusion is always easily understood and recognized. In other words, if given a model of a case of malocclusion, it is possible in a great number of cases to describe or draw the type of face that the patient possesses.

Cases of neutroclusion, with underdevelopment of the arches, always show a lack of development in the anterior part of the face. There is a pinched expression around the mouth, too short a distance between the corners of the mouth, and the lips present a wrinkled appearance as if

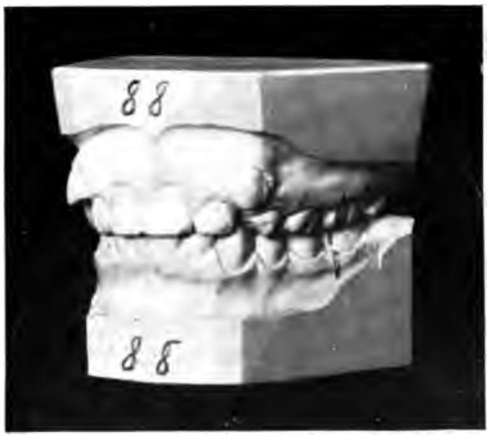


Fig. 97.—Type of malocclusion present in Fig. 96.

there was too much material in the lips and they were wrinkling. The alæ of the nose are more or less underdeveloped, are too close together, and the mouth seems too small for the face. This, in brief, is the facial expression if the patient is a normal breather. Such a type is shown in Fig. 96. Note the pinched expression of the lips and mouth, and this is what is always found in this type of malocclusion as shown in Fig. 97.

We find a characteristic facial deformity in those patients who are mouth-breathers and who still have a normal mesio-distal relation of the arches. Such a face is shown in Figs. 98 and 99. The short upper lip is characteristic, the lower lip is often tucked in and rests against the lower teeth, and owing to the fact that the pressure of the tongue is abnormal, or rather absent, the lower teeth are forced lingually by the action on the lower lip. The edges of the upper incisors rest against the lower lip, and they are forced labially. The mandible and chin may

be underdeveloped. The cusps of the teeth are generally long and well developed, which accounts for the fact that the arches are in normal mesio-distal relation when the patient is a mouth-breather.

Fig. 98. Fig. 99.

Figs. 98 and 99.—Facial casts of patient with neutroclusion, who was mouth-breather. (Parsons.)

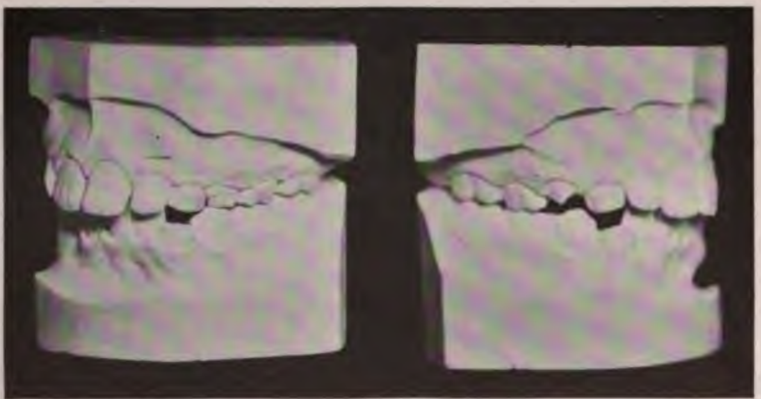


Fig. 100.—Models of patient shown in Figs. 98 and 99. Neutroclusion. Patient was mouth-breather, with abnormal lip action. (Parsons.)

The facial deformities that are present in neutroclusion are very similar, but the development of the lips may be different and will change the facial type to a certain extent. Fig. 101 shows the facial

development of a boy ten years of age. The upper lip is not functionating as it should and does not meet the lower lip, as a result of which the mouth is open and the face has the so-called idiotic stare. The lower lip is also abnormal in action and falls away from the upper teeth. The lower lip when occupying its proper position should cover the lower teeth and part of the upper teeth. It will be observed that the upper and the lower lips are thickened, and associated with this type of thick lips is an abnormal action of the glands of the lips. The saliva is viscid and stringy. The mucous glands of the lips are often closed

Fig. 101.—Showing abnormal function of the lips due to malposition of the incisors. (Lischer.)

and abnormal, which accounts for the thickness of both the upper and the lower lips. If the lips were used properly, the action would have a beneficial result on the mucous glands, and the lips would become thinner. The facial expression of this patient is made more objectionable by the spacing of the upper teeth, which in this type of lips is generally the result of abnormal frenum. Observe in this case that the lower lip does not rest against the upper teeth as in Fig. 102. This face shows an abnormal development of the lips, which may be found in cases of neutroclusion with labioversion of the anterior teeth or may be present in distoclusion cases. Such lips are characteristic of mouth-breathers who have a comparatively normal action of the mucous glands and are

therefore not thickened as is seen in Fig. 101. In Fig. 102, the lower lip lies in contact with the upper teeth, which accounts for some of the protrusion of the upper teeth. As the upper lip is short it exerts no restraining influence on the upper teeth, which are forced outward by the lower lip. The irritation of the lower lip against the upper teeth has been responsible for the thickening of the lip, which cause is different from that which produces the condition in Fig. 101.

Certain types of malocclusion are sure to produce certain facial deformities. In cases of neutroclusion with linguoversion of the maxillary incisors (Class I cases with the upper incisors in lingual relation to

Fig. 102.—Shows malformation of the lips; note especially the extreme deficiency of the upper lip; female 13 years old. (Lischer.)

the lowers), as shown in Fig. 103, we find that the lower lip is very prominent and that the upper lip is underdeveloped because of the lingual relation of the maxillary anterior teeth. The facial development is shown in Fig. 104. These cases very much resemble mesioclusion, or Class III, cases, and this is still more true when the maxillary incisors are in such a position that the patient can not close the jaw and make the molars occlude without allowing the mandible to be pushed forward. The author has seen cases of this type where, if the patient closed the jaws naturally, the maxillary and mandibular incisors would occlude edge to edge. It was impossible for the patient to retract the

Fig. 103.—Neutroclusion complicated by linguoversion of the maxillary incisors, age eleven. (Lischer.)

Fig. 104.—Facial deformity of case shown in Fig. 103. (Lischer.)

mandible sufficiently to bring the lower incisors behind the maxillary incisors which therefore made it necessary for the patient to protrude the mandible in order that the molars might be brought together. As a result of this, the mandible would be protruded, which would produce a condition similar to anteversion of the mandible. Of course, the forward movement of the mandible is only for the purpose of mastication, and at least in a number of cases seen by the author, there had not been any change in the temporo-mandibular articulation that would keep the mandible forward. The facial deformity in such a case is shown in Fig. 105. Notice the heavy appearance of the lower part of

A. *B.*

Fig. 105.—Neutroclusion, or Class I, with lingual relation of the maxillary incisors to lower.

the face, the prominent chin, the thick lower lip, and the greater fullness of the upper lip that is seen in Fig. 104. The difference in the appearance of the upper lip in the faces as shown in Figs. 104 and 105 is that in Fig. 104 there is more linguoversion or lingual position of the maxillary incisors than there is in Fig. 105. In Fig. 105, the maxillary incisors are lingual slightly, but not enough but that it is necessary for the patient to protrude the mandible when the molars are brought together.

In those cases of neutroclusion complicated by linguoversion of the maxillary and mandibular anterior teeth (Class I with bunched anterior teeth), we have a facial deformity that consists of a lack of development

around the lips (Figs. 106 and 107). These patients may be normal breathers, as was the patient from which Fig. 107 was made. The action of the lips is normal, but owing to the lack of development in the incisal regions of the upper and lower arch, the lips are sunken, they have not the proper contour, and a similar appearance exists as is found upon the extraction of some of the anterior teeth.

Fig. 106.—Neutroclusion complicated by linguoversion of the anterior teeth, age twelve. (Lischer.)

Neutroclusion, or Class I, cases present many combinations of malocclusion of the anterior teeth, and as a result of which we find an almost endless variety of facial deformities. A rather common condition of the teeth is shown in Fig. 108, in which we have a normal mesio-distal relation of the arches with infraversion or lack of occlusion of the upper anterior teeth. These cases may be the result of abnormal habits of the

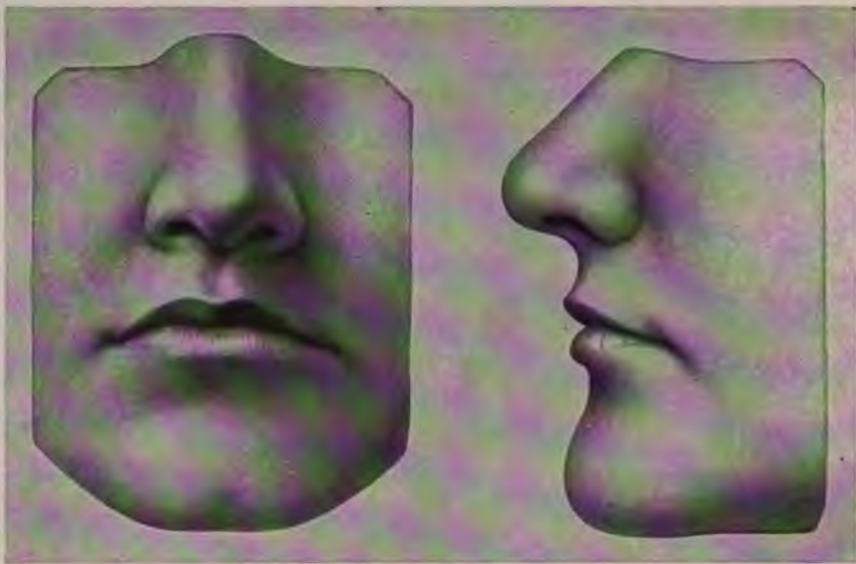


Fig. 107.—Facial deformity of case shown in Fig. 106. (Lischer.)

Fig. 108.—Neutroclusion complicated by infraversion of the anterior teeth, age sixteen. (Lischer.)

tongue or lips; they may be the result of the elongation of the molars at the time of the eruption of the second molars; or they may be associated with deformities of the maxilla and mandible as the result of rickets, and there may be some glandular disturbance of the ductless glands. Whatever the etiologic factors are, the facial deformity is always well marked and is similar to that shown in Fig. 109.

In neutroclusion, or Class I cases, and when the patients are mouth-breathers, we find abnormal action of the lips, protruding maxillary anterior teeth, an underdeveloped chin, a narrow upper arch and lack

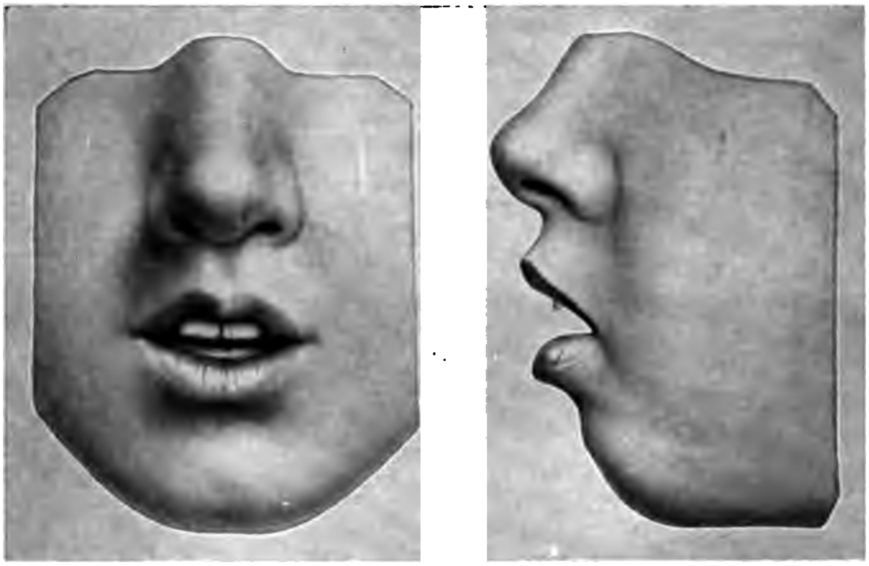


Fig. 109.—Facial deformity of neutroclusion complicated by infraversion of anterior teeth. (Lischer.)

of development of the nose—all of which has an unpleasing influence upon the face (Fig. 110).

To one familiar with the effects of malocclusion upon the face, it would be easy to conceive of the malocclusion present with the facial deformity as shown in Fig. 110. The abnormal action of the lips has had an influence upon the teeth until at the present time the malocclusion is so great that the lips cannot be closed over the teeth, which will allow the malocclusion to become more pronounced. The lack of normal action of the muscles of mastication and the resulting lack of use has allowed the mandible to remain underdeveloped. The upper arch is narrow, as is also the nasal cavity in these cases (Fig. 111).

Another type of facial deformity that is not found as often as those that have been mentioned is shown in Fig. 112. These cases call for very careful study in regard to etiology and treatment. The malocclusion consists of a prominence of the maxillary and mandibular teeth, which is generally associated with narrow arches. Early lack of development of the osseous systems and lack of development of the mandible and maxillæ have played a part in the lack of development of the face.

In considering facial deformities as related to malocclusion, we have

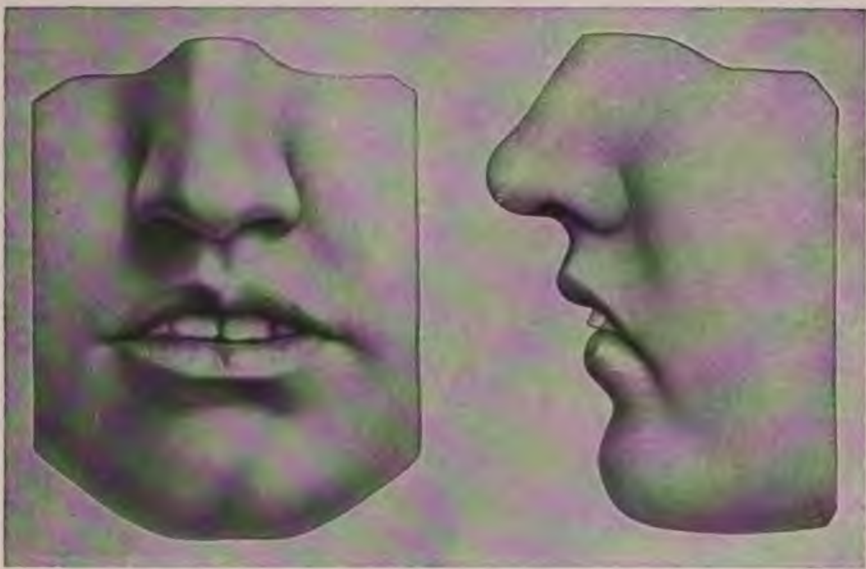


Fig. 110.—Facial deformity of case shown in Fig. 111. (Lischer.)

so far only spoken of those cases that have a normal mesio-distal relation of the arches. It is to be expected that as soon as we come to those cases that have abnormal relations of the arches that the conditions will become more marked and the facial deformities greater. Fig. 113 shows a decided facial deformity, protruding upper anterior teeth, short thick upper lip, and a thick lower lip. Mouth-breathing is present, which accounts for most of the facial deformity. The malocclusion associated with the facial deformity shown in Fig. 113 is shown in Fig. 114. The distal relation of the lower arch can be readily seen, and the protruding upper incisors that are the result of abnormal

lip action are very apparent. The lower lip has pushed the upper teeth outward, causing spaces between all of them. The extreme deformity in this case has been the result of abnormal action of the lips, and not so much the result of the distal relation of the lower arch. In proof of this Fig. 115 shows another case of distal relation of the lower arch, and the distal relation is as great as it is in the previous case. By comparing Fig. 115 with Fig. 114 it will be seen that each

Fig. 111.—Neutroclusion complicated by labioversion of the upper incisors, female, age sixteen. (Lischer.)

lower arch is equally distal. The difference in the facial outlines, as well as the different actions of the lips, can be seen by comparing Fig. 116 with Fig. 113. The facial deformity present in the distal relation of the lower arch is very much the same, and differs only as the action of the muscles differs, and as to whether the patient is a normal or an abnormal breather. In those patients who are able to close the lips and breathe through the nose, we find that the upper lip is longer and that the chin is better developed as a result of the normal breathing and

normal lip action. The greatest deformity is lack of development in the region of the mandibular incisors, which results in an abnormal mento-labial sulcus. Such a facial deformity is shown in Fig. 117.

Lischer shows a facial deformity that is due to a "malposition of the mandible; the distoclusion of the lower arch is merely a symptom." This is shown in Fig. 118. It will be noticed that the lips are closed, which indicates that the patient is at least able to breathe through the nose part of the time. The chin is better developed than the chin of the patient shown in Fig. 117.

Patients suffering from distoclusions or distal relation of the lower

Fig. 112.—Facial type of neutroclusion complicated by labioversion of the maxillary and mandibular anterior teeth. (Lischer.)

arch soon become cognizant of their facial deformity and often try to conceal it by holding the mandible in a false position.

The malocclusion in Fig. 119 is a case of complete distal relation of the lower arch, with some protrusion of the maxillary anterior teeth. The result of the malocclusion upon the facial lines is shown in Figs. 120 and 121. The underdevelopment of the mandible is very noticeable, as is the receding upper lip. In fact, the entire lower part of the face is greatly underdeveloped, and the face has the appearance of distoversion of the mandible or a distal relation of the mandible. There is no direct evidence to prove that the mandible is any farther

Fig. 113.- Showing adenoid appearance. (Duckworth.)

Fig. 114.—Showing abnormal relation of molars and extreme protrusion of the maxillary incisors. (Duckworth.)

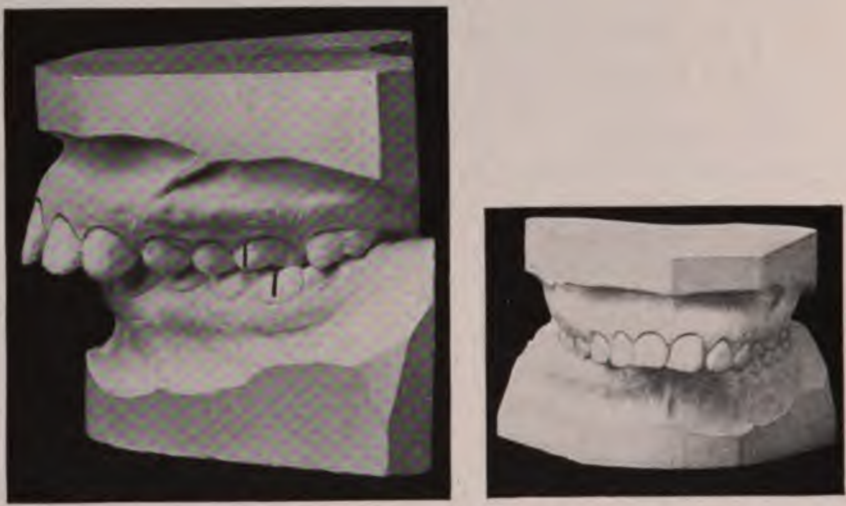


Fig. 115.—Distoclusion with labioversion of maxillary incisors. (Barr.)

Fig. 116.—Facial development of case shown in Fig. 115. (Barr.)

distal than it should be, but the chin is greatly receding regardless of the position of the mandible. The patient early recognized the facial deformity and acquired the habit of holding the mandible forward as is shown in Figs. 122 and 123. This position was the position of the mandible while speaking and during all of the hours of the day except when masticating. The effect on the facial lines by changing the position of the mandible can be readily seen by comparing Figs. 120 and 121 with Figs. 122 and 123.

The facial deformity accompanying mesioclusion, or Class III, cases is very well understood. It is one of the facial deformities with which

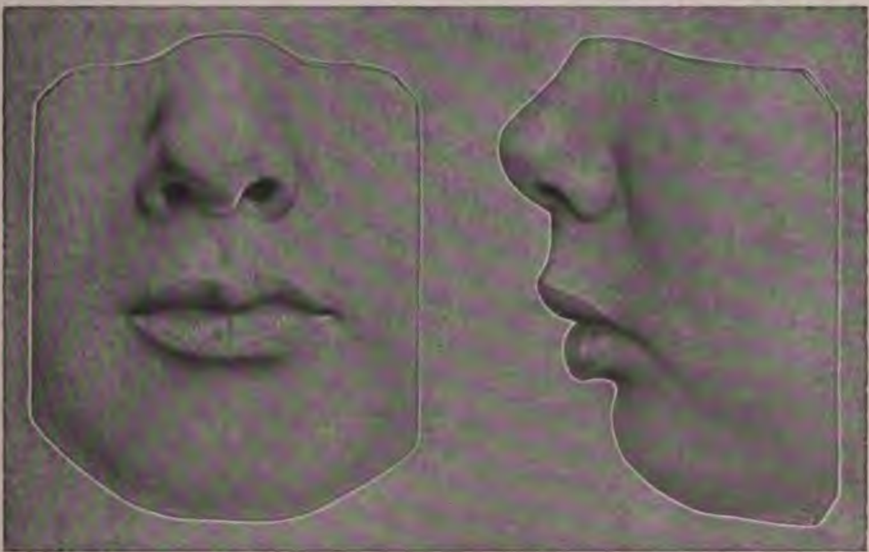


Fig. 117.—Shows malrelation of the lower lip to the upper, and abnormal mento-labial sulcus, due to distal relation of the lower arch; male 14 years old. (Lischer.)

the public has been familiar for some time. The overdevelopment of the mandible that accompanies these cases has been described by various names and has been thought to be the result of a great many conditions that have played no influence on it whatever. The facial deformity is very similar in all of these cases, the principal differences being in the extent of the overdevelopment of the mandible and in the variation in the angle of the ramus. Fig. 124 shows what may be considered a typical case of such a deformity. Another similar condition is shown in Fig. 125. A greater number of these conditions could be shown, but they are so similar that it would only be more or less a

repetition. Other cases of this type can be found in the chapter on Classification and Treatment.

Facial deformities accompanying maldevelopment of the parts are often more noticeable than those that have resulted from malocclusion. Ankylosis of the mandible, which may be the result of accident or disease, by limiting the movement of the mandible contributes to the underdevelopment of the same. Such a condition is shown in Fig. 126. It has long been known that use has played a great part in the development of the mandible, and that lack of use has had the opposite result. This is shown in the above case. The effect of use when

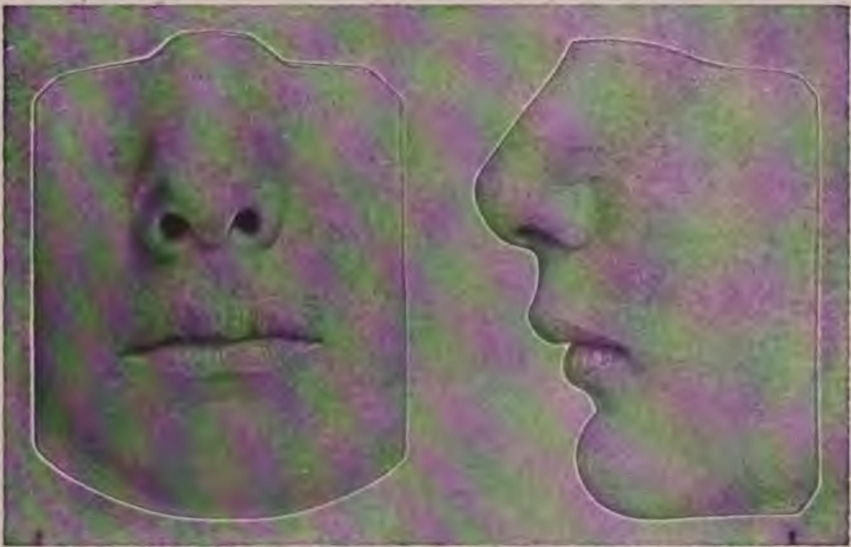


Fig. 118.—Deformity due to malposition of the mandible; the distoclusion of the lower arch is merely a symptom; male 11 years old. (Lischer.)

there is a unilateral limitation of movement is shown in Fig. 127 causing a very unpleasing unilateral facial development.

Abnormal congenital development of the maxilla and mandible produces a number of facial deformities, harelip and cleft palate being the most common. The entire absence of the mandible has been reported by some writers. A case of extreme facial deformity shown by Blair is reproduced in Fig. 128.

Malocclusions therefore produce so many different facial deformities, that it is only to be expected that a great many people who seek the services of an orthodontist, do so with a view of having the ap-

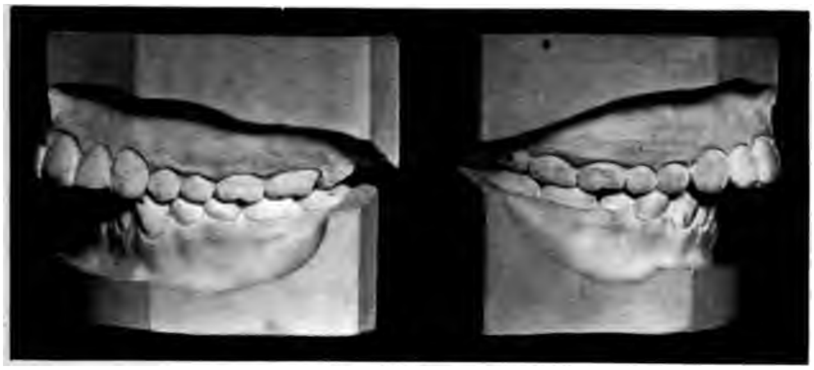


Fig. 119.—Distoclusion, or Class II. (Parsons.)

Fig. 120.

Fig. 121.

Figs. 120 and 121.– Facial views of patient with mandible in masticating position. (Parsons.)

Fig. 122.

Fig. 123.

Figs. 122 and 123.—Mandible protruding to overcome facial deformity present, and shown in Figs. 120 and 121. (Parsons.)

Fig. 124.—Mesioclusion, or Class III, with macromandibular development. (Fernald.)

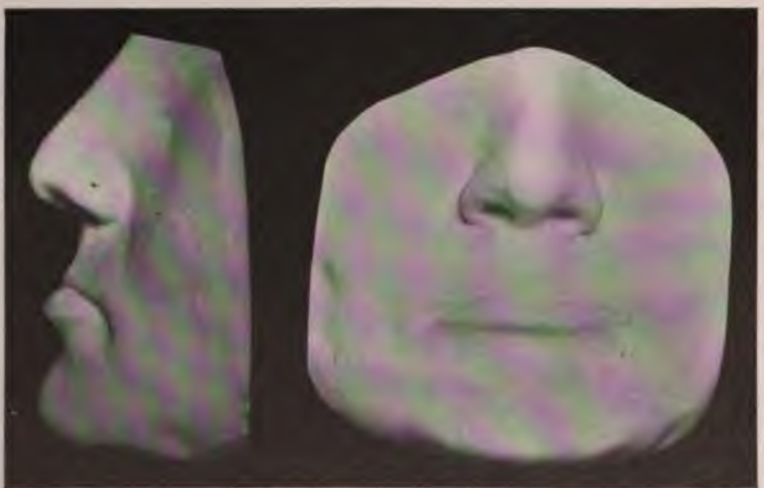


Fig. 125.—Facial deformity in mesioclusion, or Class III, case. (Parsons.)

Fig. 126.—Facial deformity due to close ankylosis at 5 years, which resulted from an injury a 3 years. (Blair.)

Fig. 127.—Facial deformity produced by lack of use. (Blair.)

pearance of the face improved. As a diagnostic aid, Lischer has mad several suggestions, which are here shown.

In neutroclusion cases, in which we have a lack of development o the alveolar process with a greatly crowded condition of the teeth, b placing wax under the lips as shown in Fig. 129 it is possible to give som

[redacted]in the face. Fig. 130, *a* and *b*, shows the
[redacted]d after the placing of the wax. In disto-
[redacted]anterior teeth, such as we find in Fig.
[redacted]uded until the teeth are brought into the
[redacted]hich is a position assuming a normal me-
[redacted]. The facial deformity is shown in Fig.

[redacted]

[redacted]mpanying a branchial fistula of the first clefts. (Blair.)

[redacted] produced by the forward movement of
[redacted]32-*b*.
[redacted]ed by the treatment of mesioclusion cases
[redacted]d, owing to the fact that it is impossible
[redacted]andible sufficiently far to show any im-

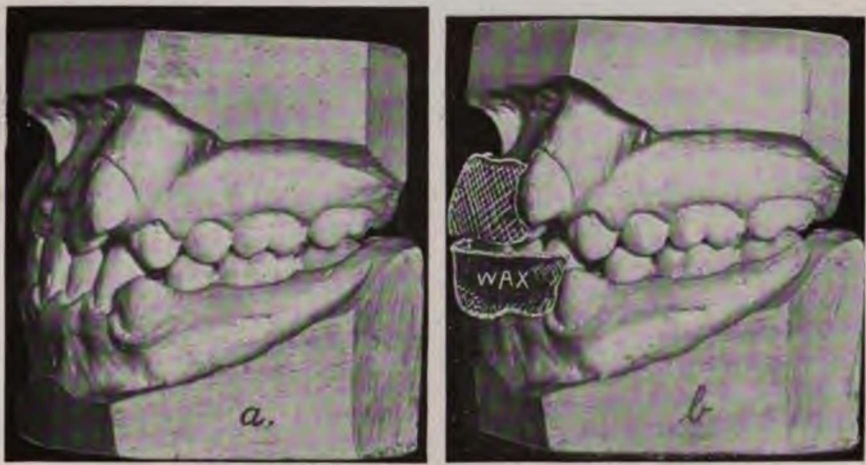


Fig. 129.—Shows Lischer's method for estimating in advance the probable effect of an orthodontic treatment; compare with Fig. 130. (Lischer.)

Fig. 130.—Photographs of patient before and after the use of the wax models shown in Fig. 129-b. (Lischer.)

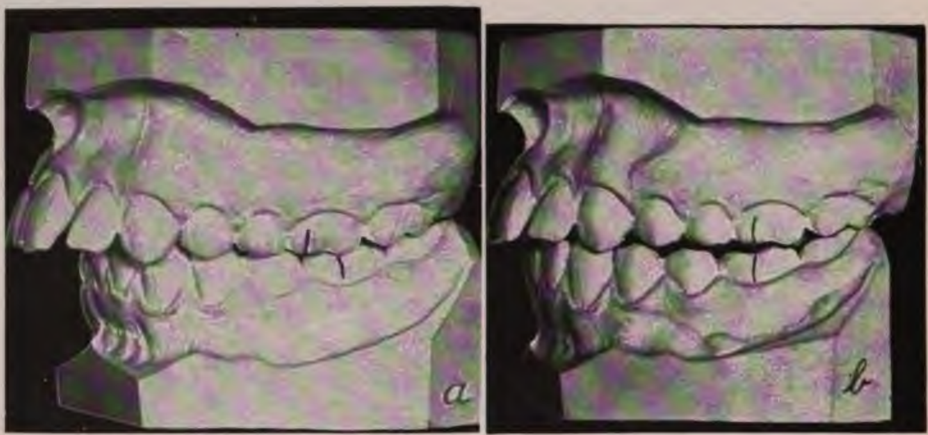


Fig. 131.—Method employed in distoclusions; compare with Fig. 132 *a* and *b*. (Lischer.)

Fig. 132.—Photographs of patient shown in Fig. 131 *a* and *b*; note change in profile in *b*. (Lischer.)

CHAPTER IV

ETIOLOGY OF MALOCCLUSION

Etiologic factors of malocclusion may be divided into two groups, based upon the time in which the factor occurs and the manner of the occurrence. As to time, they are divided into inherited, congenital, and acquired. As to manner, they are divided into local and general. General causes are also called constitutional.

General or Constitutional Causes

General or constitutional causes of malocclusion include those that affect the general functions or metabolism of the individual to such an extent as to interfere with the development of the teeth or the surrounding structures supporting the teeth. There are a number of diseases that affect the general health of the individual to such an extent as to interfere with the normal forces of occlusion and therefore produce malocclusion. There are more general diseases that affect the development of the complete dental apparatus one way or another than was formerly supposed to exist. There are a few that produce conditions that are known to have a direct bearing upon malocclusion. First would be included all of those diseases of childhood that are accompanied with high temperatures. *Scarlet fever, measles, chicken-pox* and similar diseases are known to exert a deleterious effect upon the epithelial structures. They affect the formation of the enamel of the teeth to such an extent as to produce atrophy of the enamel organ, thereby causing a tooth that is faulty in shape, which in turn destroys the force of the inclined plane or the approximal contact. *Syphilis* has long been considered as a disease that produces atrophy of the enamel organ, and there is little doubt but that it does produce certain forms of crowns, which have been referred to as "Hutchinson's teeth," but there are also a great many other diseases that produce the same kind of crowns. In some cases, the general disturbance may be so great as to destroy the tooth germ entirely, which would then produce a cause of malocclusion, namely, missing teeth.

Rickets is another general disease that produces a great many cases of malocclusion. Rickets is a disease of malnutrition characterized by faulty bone formation. As a result of the faulty bone formation

proper support is not provided for the teeth. The teeth being supported by a faulty calcified alveolar process, have not enough support to prevent them from assuming a position of malocclusion under the stress of mastication. The muscles of mastication exert force upon the bone which results in deformity of the bone. The body of the bone, as well as the alveolar process, is abnormal and the pull of the muscles of mastication causes the mandible to straighten out at the angle, which results in an elongated and deformed mandible. Blair considers such deformities of the mandible as a sure indication of early rickets. The alveolar process is greatly thickened, as shown in Fig. 134, and this thickening of the alveolar process can be seen as thick ridges in the living individual. The gums are thick and more or less inflamed. In those cases where a thick alveolar ridge is encountered the practitioner

Fig. 133.—Skull of opossum that suffered from rickets. (Bebb's Collection.)

should be careful in making promises as to what the final outcome of the case will be; for in rickets the teeth can be moved, but they will move to some position of malocclusion under the stress of mastication just as easily as they move with an appliance. Rickets has been described as a disease of childhood, but it may also make its appearance in the middle-aged, and several cases have been reported in pregnant women and in nursing mothers. It is plain to be seen that if the mother was rickety the teeth of the child would be doubly affected. With rickets, the deciduous teeth erupt late, and there is a general deformity of the skull and jaws in the more extreme cases. However, children may have rickets and the disease not be diagnosed as a general disturbance and still the disease will be the cause of extreme malocclusions. We have stated that the deciduous teeth are erupted late and the conditions with regard to malocclusion are made worse, owing

to the fact that the deciduous teeth are lost early. The roots are absorbed without any apparent reason. With regard to the permanent teeth, they erupt late, and if the disease is rather marked, owing to the deformed jaws and processes, they take extreme positions of malocclusion. The upper arch is always narrow and contracted with a tendency to the formation of thick ridges in the palate located to the lingual side of the molars and premolars. The lower dental arch is usually wide in the molar and premolar region, with the crowns of the teeth turned in and the apices of the roots turned buccally. Rickets may

Fig. 134.—Superior maxilla of ape that died from rickets. (Bebb's Collection.)

be present for only a short time, but this will be long enough to disturb some of the forces of occlusion, which will cause the malocclusion to start, and the case will then be made worse by other conditions that develop later in life. It must be remembered that, as rickets is a disease of malnutrition, it is found in the two extremes of society—the rich and the poor. The great middle class who have sufficient of the coarser foods and are able to live in good surroundings are free from rickets as compared with the poor who have to live in the poor surroundings and with the rich who have sufficient food but food of the improper kind. It is from this latter class that most of the orthodontic

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cases are seen in private practice with rickets. It must also be remembered that we may find the disease in varying degrees of severity, and as a result of this the disease will produce different types of malocclusion depending upon the other causes that may be present.

It has long been recognized that the early loss of the deciduous teeth would produce malocclusions, and as this is one of the conditions that is always present in rickets, we have little doubt that rickets has produced many cases of malocclusion in which this primary cause has never been recognized. The predisposing factors in the production of malocclusion are made more manifest, when we remember that the late eruption of the permanent teeth always causes malocclusion and that it is also one of the results of rickets. Patients who are rickety are also prone to be mouth-breathers and to suffer with enlarged tonsils and adenoids. In fact, the hypertrophy of lymphoid tissue is another link of the chain of conditions that is found in rickets and another of the conditions that produces malocclusion. Figs. 135 and 136 show a case of malocclusion in which there was a history of rickets, and the malocclusion is typical of those conditions. The upper arch is narrow, with thick gums and alveolar processes, wide lower arch in the region of the molars and premolars. The facial development of the patient showed a deformed mandible; one in which the angle was made obtuse by the action of the muscles of mastication. In treating this case the teeth moved very easily, and in retention they moved to new positions of malocclusion just as easily. More will be said in regard to these conditions under treatment.

Tuberculosis also produces conditions that affect the teeth, but they are not so severe as those produced by rickets and the results are almost directly opposite. A child suffering from tuberculosis will erupt the deciduous and permanent teeth early. After a deciduous tooth takes its place, the root will not be absorbed as it should and the permanent tooth will take a position somewhere to the side of it. However, the deformity caused by the prolonged retention of a deciduous tooth does not produce the harm that the early loss of the deciduous tooth would produce.

The reason why these two constitutional diseases should act as they do has not been fully explained, but a great many who confine their practice to the diseases of children have tabulated the conditions as herein mentioned.

Another constitutional condition producing malocclusion is the *faulty development of the child,* which may be the result of several conditions.

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the development of the child to such an extent that the child will also be poorly developed and poorly nourished. It is a well-known fact that the calcification of the deciduous teeth, and certain of the permanent teeth, begins before birth. Therefore, if before birth, the mother is poorly nourished we would expect improper calcification of the deciduous teeth and some of the permanent teeth and improper calcification of the mandible and the maxilla as well as the disturbance of other general organs.

It is a well-known fact that children born of mothers who have been forced to do a large amount of physical labor during pregnancy, who are overworked and underfed, give birth to children who show physical imperfections in a great many respects. While some of these physical conditions may be apparent, there are other conditions that pass unnoticed but which exert a deleterious influence later in the life of the child, and this influence may make itself apparent by the production of deformities in the teeth and jaws. Certain constitutional conditions that may be said to be congenital have been acquired from the mother during pregnancy and they play a very important part in the development of malocclusion, although the malocclusions may not make their appearance until much later in the life of the child. It must also be remembered that the child who has been improperly nourished during embryonic life will also be subjected to a greater degree to the influences of environment, and will be more susceptible to disease than the child who developed from the embryo that was properly nourished. As a result of this, we shall find that some conditions will produce malocclusions in one child, while a similar condition would be thrown off and have no apparent effect on another child. It must, therefore, be remembered in studying the etiologic factors of malocclusion that a great many cases that are obscure as to the cause really have their beginning in the embryonic period and are the result of constitutional conditions that developed during the embryonic life. Cell metabolism or faulty development plays a much greater part than has been supposed. The long period of time during which it can act, and is in an active state, and every angle of the physical and embryologic development of the child make it a factor to which more attention must be given, one which must be recognized to a greater extent than heretofore. We might therefore divide constitutional conditions into three periods. Constitutional conditions or developments that are the result of conditions of health transmitted by the germ cells or are the result of the physical vitality of the germ cells at the time of fertilization; constitutional conditions that may arise during the congenital period

and that are the result of environment or physical conditions in which the mother lived; and last, constitutional conditions that are the result of environment in which the child lives. The third factor plays a great part in the production of malocclusion, and of course will play a part depending to a certain extent upon the other two factors.

However, it is a well-known fact that children may have developed normally as the result of hereditary influences, as a result of the transmitted physical conditions of the germ cells, and during the congenital or prenatal period, but that they will develop malocclusions as a result of the environment in which they live. These environments produce malocclusions as constitutional disturbances, owing to the fact that the environment affects the entire physical condition of these youngsters. As a result of these environments in which the child lives and as a result of constitutional conditions that are produced thereby, we may say that a certain number of malocclusions are the result of civilization.

One of the greatest factors in the production of malocclusion today, acting in a constitutional manner, is the effect of food and diet upon the teeth directly and upon the constitution as a whole. In order for the osseous structures or calcified tissues to develop, the children must have the proper kind of food, and a large number of civilized youngsters do not have the proper kind of food. The children of the better class of people or the rich people are particularly liable to be affected in this manner because the child is very likely to eat food containing a large amount of starch and sugars, a large amount of meat, and food that contains very little of calcified tissue-builders. Foods should be used that contain lime, salts, and similar substances, such as are present in whole-wheat bread and also present to a large extent in certain vegetables and vegetable fibers. As a result of improper diet, the osseous structures of the individual will not be properly developed, on account of the fact that the eating of this improper food does not require the proper usage of the jaws. It is a well-known fact that for any organ to be developed it must be used, and this is equally true in regard to the teeth and their supporting structures. The child is not receiving the food that requires the proper mastication, so the teeth are not used and pressure is not brought to bear upon the teeth, and therefore no pressure is transmitted to the alveolar process and the structures supporting the teeth.

As the teeth are not properly used, there is not the proper circulation

to the parts and therefore not the proper development. Associated with the improper usage of the teeth or lack of use will also be a lack of action brought to bear on the muscles surrounding the teeth and jaws. As a result of disuse there is a lack of muscular development, a lack of the stimulating influences produced by muscular activity, and the entire face and jaws of the child do not develop properly because of this lack of function. We see a great many children who have perfectly normal deciduous teeth as far as the shape of the teeth and the shape of the arches are concerned, and everything indicates if they would live properly and in the proper environment that they would have a normal permanent dentition. However, without any apparent reason, so far as we can find direct pathologic factors, the child does not develop, its face does not grow properly and the dental apparatus is not developed sufficient to accommodate the permanent teeth. This lack of dental development is the result of faulty cell metabolism and the lack of growth that is produced by the lack of use. We maintain that this is the result of the lack of use, because in the early life of the child he had the physical development that produced a normal set of deciduous teeth. Everything indicates that he started out along a normal path of development but that for some reason, between the time of eruption of the deciduous teeth and the eruption of the permanent teeth, something has gone wrong in nature's plan and the permanent dentition has not developed to a normal shape and size. This something that has gone wrong is in the majority of cases the result of the environment in which he lives, the lack of use to which the teeth have been put, the lack of function of the muscles of mastication, and a general lack of development that has been produced by lack of use. In other words, the malocclusion has been the result of the environment in which he lives, and that environment has affected the constitutional development or conditions of the youngster to such an extent that malocclusions are present. We find that malocclusions make their appearance in different races provided that the races live in such an environment as we have described. We find that malocclusions are present among the civilized Indians who are living in luxury, among the negroes who are living as white people live, so we can safely say that racial characteristics are neither a preventive of malocclusion nor a producer of it. Many malocclusions are the result of the environment in which the individual lives, the result of disuse that affects the constitutional development, and thereby produces the malocclusion.

In examining skulls of ancient races, such as the one shown in Fig. 137, which is the skull of an old Indian, we find the teeth well developed, the jaws well developed, and a large amount of wear shown in the teeth. If the modern individual used his teeth in such a manner as the semi-savage used his, a large amount of malocclusion that is the result of environment and lack of use would disappear and normal occlusions would be much more common in the civilized man than they are at present. It must be remembered then that a large number of the obscure cases of malocclusion have their origin and faulty

Fig. 137.—Showing well-developed jaws and wear of teeth as a result of use.

cell metabolism in a faulty development and that this faulty development may reach far back into the period that may be said to be the period of environment in which the child lives, to be a congenital condition that has been acquired during embryonic life, or even to be a constitutional condition that may be produced by the physical nature or condition of the germ cells. Constitutional conditions as the cause of malocclusion must have a much greater study than they have received in time past.

Another factor that is the cause of faulty developments and that

plays a part in the development of malocclusion is disease of the ductless glands of which very little is known. It is known that diseases of the pituitary bodies have a tendency to produce overdevelopment and are especially liable to produce overdevelopment of the mandible. Not only will it produce overdevelopment of the mandible but it will affect the development of the other bones of the face to a certain extent, but the overdevelopment of the mandible is more apparent, because in the development of that bone we have the malocclusion produced directly. A great many cases of so-called mesioclusion, or Class III, have been the result of the development of the mandible, which really are conditions arising from overgrowth of that bone, and therefore are a macromandibular development. Diseases of the thyroid will produce a lack of development of the osseous structure and very probably a great many of our patients who show a lack of osseous development are children who are suffering from thyroid deficiency.

In a prognosis of these conditions it is well to be on our guard and not to make too positive a statement as to what can be done in the treatment of malocclusion, for very often the malocclusion is the result of the constitutional condition that may at the present time be beyond the control of even internal or general medicine. The known facts at present seem to indicate that a larger number of malocclusions are produced by constitutional conditions and that instead of malocclusion being purely a local proposition as the result of disturbed mechanical factors, as was formerly supposed, we have to admit that a great many malocclusions are the result of disturbed cell metabolism, which is now considered as the first and most important force of occlusion. Furthermore, if normal cell metabolism cannot be established the malocclusion will be more or less permanent and the treatment of it unsatisfactory.

Another constitutional factor that plays a great part in the production of malocclusion, which has been referred to indirectly, is that which is the result of early feeding of the youngster. We refer particularly to the prevalence of malocclusion in bottle-fed babies as compared with the children who are breast-fed. Bottle-fed babies are probably improperly nourished, owing to the fact that the modified milk that they receive does not contain some of the elements that are present in mother's milk, even though chemical analysis would seem to indicate that it is the same. In the investigations made by Hellman, extending over a number of years, he has found that malocclusions in bottle-fed children are much more numerous than malocclusion in normally fed children. Therefore, malocclusion, instead of being the condition that

may arise during the few years of child life, is probably the result of conditions that extend over the entire developmental period of the youngster, beginning with the germ cells, and extending over a period of time until the death of the individual. In other words, there is no period in the life of the person when he is existing either as a single cell or as a complete organism, that the constitutional conditions cannot be manifested, and there is no period during that time when constitutional conditions may not occur that will produce malocclusion of the teeth.

Local Causes

Local causes of malocclusion are those that act directly within the oral cavity and its parts. They include such conditions as affect the

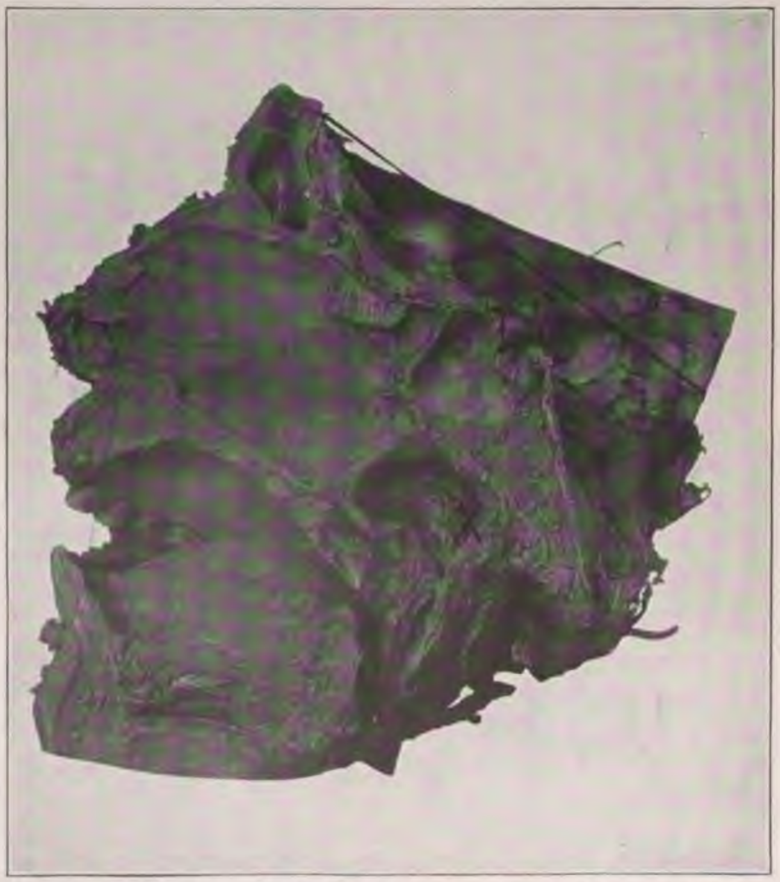

Fig. 138.—Showing nasopharynx, hard and soft palate, and location of adenoids shown at X.

teeth and surrounding structures. At first it would seem easy to separate local from constitutional causes and a number of those conditions are easily separable. However, there are other conditions that may be said to be both local and constitutional, and it is hard to determine which may have been the primary cause. In discussing constitutional causes, we stated that rickets caused an early loss of the deciduous teeth and the tardy eruptions of the permanent teeth. These two things would act locally while the cause of them would be constitutional. But, as before stated, these local conditions are the result of a constitutional condition. Mouth-breathing has long been given as a local cause of malocclusion because it disturbs the muscular and atmospheric pressure and acts directly upon the surrounding structures. The majority of cases of mouth-breathing are caused by hypertrophy of the lymphoid tissue located in the naso-pharynx, also known as the pharyngeal tonsil (see Fig. 138). Therefore the real cause of the mouth-breathing is the adenoids, which may be the result of a constitutional condition or of the environment in which the child is living. The local disturbance is the direct cause of the malocclusion, but the factor that caused the adenoids may have been overlooked. When we look at some causes in this light we are forced to admit that the line between the local and constitutional causes blends together to such an extent as to be almost inseparable. However, the majority of malocclusions are surely the result of local disturbances or the result of environment. As there are a great number of local causes, this subject will be discussed more thoroughly later. We will now take up a different plan of classification of causes.

Inherited, Congenital and Acquired Causes

The causes of malocclusion may be divided again into three groups, according to the time in which they originate or according to the time of origin. They are hereditary, or inherited, congenital, and acquired.

Inherited Causes.—An inherited condition is one that is transmitted from the parent to the child. An inherited malocclusion would be one that was present in the parent and transmitted to the offspring. Owing to the fact that much has been written on the inheritance of malocclusion, it will be necessary to review some of the theories for and against, as advocated by authorities formerly and at the present time. The evidence may be divided into biologic and clinical. From the standpoint of biology, anatomy, histology and embryology, there is no evidence that malocclusion is ever inherited. The author has seen but

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the forces of occlusion so as to produce
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family traits by other authors are not the

result of the transmission of the malocclusion, but the result of acquired conditions that are the same in each individual.

Certain constitutional diseases may also produce malocclusions in the child that are the same as those present in the parent. Rickets is one of the diseases that often affects both the child and the parent, and because the child has the same malocclusion as the parent the malocclusion is charged to inheritance when it is the result of disease. A certain type of malocclusion that is prevalent in one of the royal families of Europe has often been attributed to inheritance when clinical facts indicate that the entire family has suffered from rickets.

Certain forms of malocclusion are sometimes found in different members of the same family and the cause of the condition may often be obscure. However, because we cannot locate the trouble, does not prove that the malocclusion is inherited. The author has seen three cousins in three different families who had very peculiar malocclusions, all very similar, and nothing could be found that should produce such a condition. The author has seen all of these cases under treatment, and the treatment of all has been very slow and unsatisfactory, which would indicate some constitutional condition was playing an important part in the production of the malocclusion. The malocclusions are not present in any of the male cousins of the family. Unfortunately, from a scientific standpoint, the three families are small, which reduces the law of average so much as to make it useless.

Cases with the same type of malocclusion may be present in children of the same family and inherited factors may be thought to be the cause of these conditions, but at the present time, we have not sufficient knowledge to prove that they are the result of inheritance. Figs. 139 and 140 are those of sisters that present very similar malocclusions. Figs. 141 and 142 represent the right sides of the same cases. The cause of these cases may be difficult to determine, but it probably was the same constitutional condition or the same acquired factors in each case, and not the result of inheritance.

We find another class of conditions mentioned by those who advocate the inheritance of malocclusion, which class has been called the *intermarriage of races* or the *mixing of types*. They maintain that a certain number of malocclusions that are very often found are the result of the marriage of parents who are of different physical size. For instance, they say that a child will often inherit the teeth of a large father and the jaws of a small mother, resulting in a condition in which the teeth are too large for the jaws. No explanation has ever been made as

to how such a condition could occur. To any one who is familiar with the development of the teeth and jaws it becomes absolutely impossible to accept such a doctrine. The child's teeth are not formed from one group of cells and the jaws from another, but both come from the branchial skeleton, and up to a certain time it is impossible to say which cell is going to develop into a tooth and which cell is going to develop

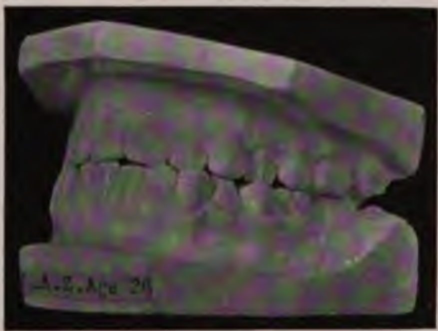

Fig. 139.

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Fig. 141.

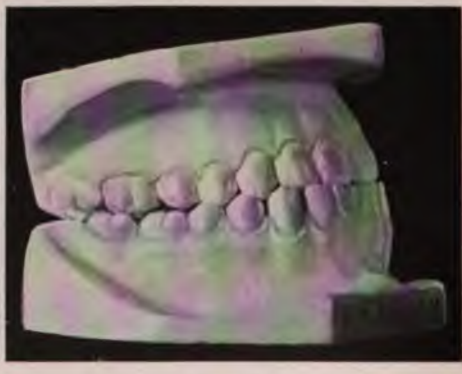

Fig. 142.

Figs. 139, 140, 141 and 142.—Similar types of malocclusion in members of the same family. Claimed by some to be inherited. (Zentler.)

into the jaws or bone supporting the teeth. The size of the child's teeth was determined at the time of the fertilization of the ovum. From that time on until the eruption of the permanent teeth, if the child leads a perfectly normal life, and is not influenced by any other acquired cause or constitutional disease, the arches will be large enough for the teeth. The size of the teeth, that is, the enamel of the teeth, will

not be changed unless there is an actual destruction or atrophy of the enamel organ. However, the size of the bone or the jaw supporting the teeth depends upon the environment of the individual, and there are a number of conditions that will retard the development of the jaws

Fig. 143.—Supernumerary teeth, congenital cause of malocclusion.

Fig. 144.—Supernumerary teeth, congenital cause of malocclusion.

and produce malocclusion of the teeth. The author has never seen a case of malocclusion that has been the result of such inherited conditions as have just been mentioned, nor has he ever had an opportunity

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We may find a few cases where the par-
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premaxillæ with the maxillary bud, and
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is *supernumerary* (Figs. 143 and 144)
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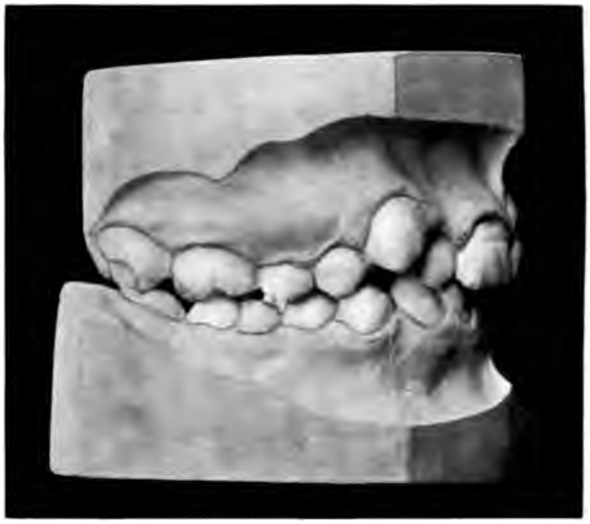

Fig. 145.

Fig. 146.

Figs. 145 and 146.—Missing tooth (maxillary second premolar), congenital cause of malocclusion.

In examining a large number of newly born children with reference to the attachment of the frenum labium, it has been found that the frenum is always attached at a point close to the gingival border of the gum. It is also large and thick. The lower frenum, as well as the

Fig. 147.—Congenital missing maxillary second premolar.

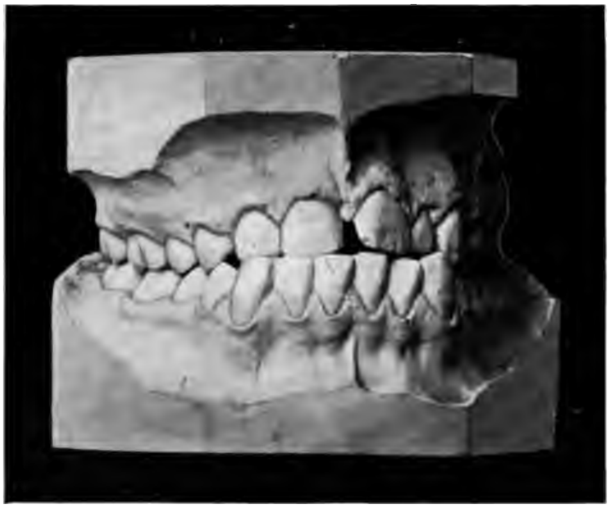

Fig. 148.—Missing lateral incisor, congenital cause of malocclusion.

upper frenum, may be well developed. As the child grows older and the deciduous teeth erupt, we find that, in the majority of cases, the teeth and alveolar process grow downward or gingivally away from the attachment of the frenum, with the result that the attachment of the

frenum is at a more apical point compared with the gingival border than it was at birth. There is also a tendency for the frenum to decrease in size. The frenum is large and attached close to the gingival border at birth, but as the teeth erupt it becomes attached at a point farther from the gingival border, because the teeth and alveolar process grow away from it. In abnormal cases, the attachment of the frenum continues to grow downward or gingivally with the gingival growth of the teeth and process, with the result that the attachment is always between the teeth and causes a space to exist between the incisors. We find some cases in which the deciduous teeth will be normal and the attachment of the frenum during the time the deciduous incisors are present will also be normal. However, with the eruption of the permanent teeth, and the growth of the alveolar process, the attachment of the frenum grows gingivally as the permanent teeth erupt. This results in the appearance of an abnormal frenum in a case that has been previously normal.

Fig. 149.—Abnormal frenum labium, congenital cause of malocclusion.

The frenum may be abnormal in the upper or lower lip, but the majority of abnormal frenums are found in the upper lip. In a few instances we have seen the frenum abnormal in the lower lip and the upper lip presented a normal condition. Associated and with abnormal frenums, may be a thickened and abnormal lip. The lip presents the appearance of having too much tissue in it and produces a very bad facial deformity, besides the deformity produced by the malocclusion. In some cases, the frenum will be too short, which will retard the action of the lip, and it will be impossible for the patient to use

the lip as he should or to raise the lip in smiling to give the proper facial expression.

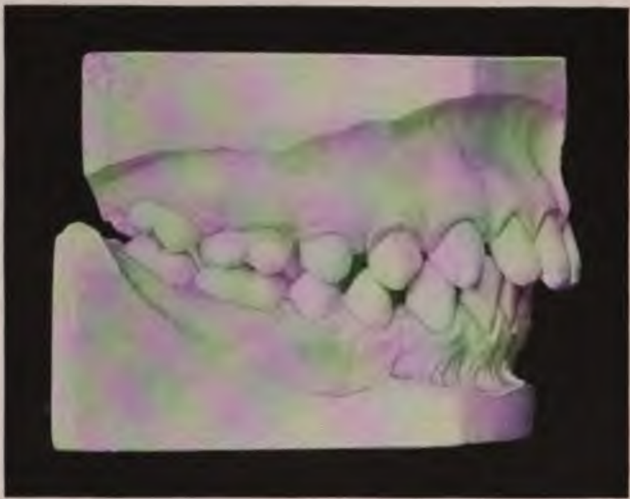

Fig. 150.

Fig. 151.

Figs. 150 and 151.—Result of oversized tongue, which may be congenital.

Other congenital conditions may be *large* or *oversized tongue* (Figs. 150 and 151), or *undersized tongue;* although the latter condition oc-

curs very rarely and complete data in any great number of these cases have not yet been worked out.

In considering inherited, congenital, and acquired causes of malocclusion, the time of the appearance of the factors that produce the malocclusion must be kept in mind. The individual is the result of the union of the male and female germ cells and everything that is inherited is present in the germ cells at the time of the union. After the union of the male and female germ cells and while the individual is in utero the congenital conditions make their appearance, some of which are the result of inherited conditions and some are the result of environment upon the mother. Such congenital conditions as are normal are always inherited, but a great many of the abnormal congenital conditions are the result of environment. After the birth of the individual, the acquired conditions arise which may aid in the normal development of the person, or which may so affect the body as to produce pathologic conditions or developments. The effect of inherited,

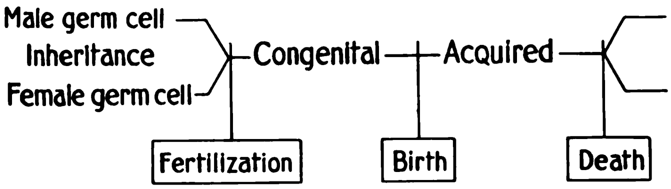

Fig. 152.—Diagram showing time in life when inherited, congenital, and acquired factors are active.

congenital and acquired conditions on the growth of the body may be shown by a diagram in Fig. 152. The first part of the diagram with the two lines represents the male and female germ cells, which carry all of the characteristics that will be transmitted. As the two lines come together at fertilization, we have the beginning of a new individual who has all of the characteristics that can be transmitted, and who is now living under a congenital condition that may be normal, or that may be abnormal. The environment of the mother will influence the growth of the embryo and a great many constitutional conditions are begun at this time that will later develop into malocclusions. At birth, the individual is thrown upon his own resources, and environment affects him more than it did during the congenital and inherited periods. From birth to death conditions may arise that will have a bearing on the production of malocclusion. As a result of the study of this chart, it will be seen that acquired factors are more responsible

Fig. 153.—Malocclusion produced by early loss of deciduous incisors.

Fig. 154.—Early loss of deciduous lateral has allowed maxillary central to drift toward the right side. Mandibular lateral is nearly in contact with deciduous molar.

for the production of malocclusions than any of the other factors, but it must be remembered that a large number of constitutional conditions are the result of congenital conditions that do not manifest them-

Fig. 155.—Maxillary canine out of line because of early loss of deciduous canine.

Fig. 156.—Mandibular canine crowded labially because of contracted arch due to early loss of deciduous canine.

selves until after birth. Such things as faulty development or cell metabolism, as a result of an improper environment of the mother, and improper nutrition of the embryo that results from improper health of the mother, must always be considered in the study of acquired causes.

Acquired Causes.—Acquired causes of malocclusion are those that occur after the birth of the individual. They are the result of the environment in which the individual lives. Acquired causes may be either local or constitutional. The majority of conditions that produce malocclusion of the teeth come under the head of acquired causes.

Fig. 157.—Early loss of deciduous molar has allowed permanent molar to drift forward.

Early Loss of the Deciduous Teeth

The early loss of the deciduous teeth may be constitutional, as, for instance, when it is associated with rickets; or it may be local when caused by decay, or early extraction. Malocclusion is bound to develop regardless of whether the deciduous tooth has been lost as a result of local or constitutional conditions. The early loss of a deciduous incisor, above or below, will produce a lack of development in the region of the incisors (Fig. 153). The loss of the force of the approximating teeth will permit them to drift together. The early loss of a deciduous second incisor will allow the first incisor to drift toward the canine and

close the space, which will result in an impacted permanent lateral. The early loss of an upper or lower deciduous canine will permit the incisor to drift toward the side from which the tooth is missing (Fig. 154) until very often the lateral incisor comes in contact with the first deciduous molar. As a result, the dental arch will be too small to accommodate the permanent canine, which will appear as in Figs. 155

Fig. 158.

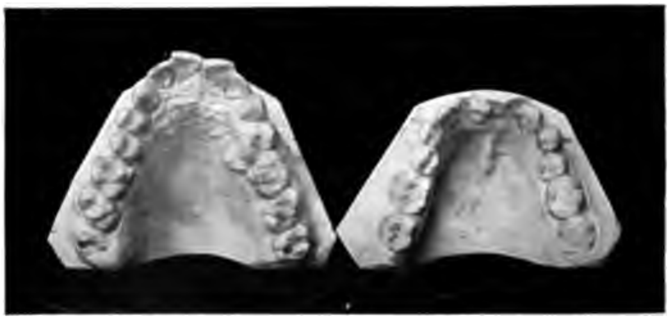

Fig. 159.

Figs. 158 and 159.—The maxillary molars have taken a mesial position as a result of the early loss of the deciduous molar and the premolar is impacted as shown in Fig. 159.

and 156. The loss of a deciduous molar will permit the permanent molar to drift forward (Fig. 157). This will result in an abnormal mesiodistal relation of the first permanent molar and will also often result

Fig. 160.—Loss of permanent molar, acquired cause of malocclusion.

Fig. 161.—Loss of mandibular first molar.

in an impaction of the premolar when it attempts to erupt (Figs. 158 and 159). Given the loss of any of the deciduous teeth, it is possible to describe the malocclusion that will result in a few years from that time.

Tardy Eruption of the Permanent Teeth

Tardy eruption of the permanent teeth is an acquired characteristic that is very often the result of a constitutional disease, as rickets; or it may be the result of a poor physical development that prevents the proper calcification and eruption of the teeth. If the deciduous teeth have been lost, either as the result of constitutional disease or as a result of local cause, the space that remains vacant by the non-eruption of the permanent tooth will be closed by other teeth drifting toward each other, because of the loss of the approximal contact. The longer the permanent teeth are delayed in eruption the more complicated becomes the malocclusion.

Early Loss of the Permanent Teeth

Early loss of the permanent teeth produces a large percentage of malocclusions found in adults, and malocclusion will result from the loss of any permanent teeth at an advanced age. The early loss of the first permanent molar (Figs. 160 and 161) produces a malocclusion which is very difficult to treat, which does a great amount of damage to the occlusion of the teeth. It destroys the masticating apparatus of the patient, and this is a predisposing factor to pyorrhea. Malocclusion is sure to result irrespective of the age at which the first molar is lost; neither does it make any difference whether the lower and upper molars are lost on the same side or on opposite sides (Fig. 162); nor whether one or all of them are lost. The malocclusion will result, and result in such a positive manner that it is possible to foretell what is going to take place by knowing the time at which the molar is lost. Some authors have advocated the extraction of the first permanent molar for the correction and prevention of malocclusion, explaining that the second molar would move forward and take the position occupied by the first molar. This is a false theory, and one that has caused no end of trouble. Loss of the lower first molar permits the lower second molars to tip forward half the width of a tooth (Fig. 163), and the teeth anterior to the lower first molar will drop back half of the distance (Fig. 164), which will destroy the occlusion on that side of the mouth. In addition to this malocclusion

Fig. 162.—Loss of mandibular and maxillary first molars.

Fig. 163.—Loss of mandibular first molar at early age.

there will occur an overlapping of the maxillary anterior teeth and the mandibular incisors will drop distally (Fig. 165) so far as to occlude against the gingival of the maxillary teeth. The facial deformity that is produced is one in which the chin is too close to the nose (Fig. 166). The loss of both mandibular first molars would simply make the maloc-

Fig. 164.—Malocclusion produced by loss of permanent mandibular molar.

Fig. 165.—Excessive over-bite produced as a result of extraction of mandibular permanent molars.

clusion more pronounced and the facial deformity more noticeable. The loss of all four first molars would produce a very similar type of malocclusion, destroy the approximal contact of all of the teeth and ruin their masticating efficiency, bringing about an inharmonious expression of the face. The reason that the loss of all four first molars destroys the approximal contact point and the facial expression, with a tremendous

Fig. 166.—Facial deformity caused by loss of mandibular first molar in Fig. 163.

loss of masticating efficiency, is because the upper and lower first molars have entirely different shapes and are different in mesio-distal diameters, and the teeth mesial and distal to them tip as the teeth drift together.

The Loss of the Mesio-Distal Diameter of the Teeth

Malocclusion will result in the premature loss of the deciduous or permanent teeth, because the approximal contact of that arch has been destroyed, which results in a mesio-distal shortening of that particular lateral half. The loss of the mesio-distal diameter of the lateral half of the arch is not so great as the loss of the entire tooth. The loss of the mesio-distal diameter of the tooth is generally the result of caries with improper treatment of the same. A large number of malocclusions are produced because of the loss or decrease of the mesio-distal diameter of the deciduous molars. It is a well-known fact that the deciduous molars are wider mesio-distally than the premolars. This has caused many to believe wrongfully that it is possible to allow the

mesio-distal diameter of the deciduous tooth to become less than normal without producing any serious effect. This is not true. The loss of a mesio-distal diameter of a deciduous molar as a result of caries will always result in the displacement of the first permanent molar. If the loss is still greater it will result in the impaction of the premolar. Therefore, to avoid the loss of the mesio-distal diameter of deciduous teeth it becomes necessary that the treatment be such as will retain the original diameter. They should be filled with some substance that will maintain this mesio-distal diameter. The tooth must be restored to the original shape, size, and proper contour. It very often follows, in mesial or distal approximal cavities that have been present for some time in molars and premolars, that the teeth have drifted together, destroying the mesio-distal diameter of the tooth and the mesio-distal length of the arch. As a result of the loss of the mesio-distal diameter of the teeth, the cusps will not occlude properly and there will be inharmony in the size of the arches.

Improper Restoration

We have mentioned the loss of the approximal contact of the deciduous teeth which destroys the mesio-distal diameter of the teeth, and the same can be said of conditions found in the permanent teeth. We should also call attention to improper restorations of the teeth. Very often such restorations are not properly made so as to replace the mesio-distal diameter, and fillings and inlays do not always have the properly shaped approximal contact point. The force of the approximal contact point is one of the normal forces of occlusion, and failure to properly restore contact is a cause of malocclusion. The occlusal surfaces of the teeth are not always properly restored, thereby destroying the force of the inclined plane. A great many cases of malocclusion are the direct result of improper restoration of the teeth as well as improper occlusal surfaces of crowns and bridges.

Mouth-Breathing

Mouth-breathing has long been recognized as a cause of malocclusion, and is generally the result of adenoids. There are other conditions that cause mouth-breathing, but the large percentage in children is produced by adenoids. Adenoids may be defined as the hypertrophy of the lymphoid tissue located in the naso-pharynx. Lymph-

oid tissue is present in all children and becomes the cause of mouth-breathing only when it is infected and congested to such an extent that it extends downward and forward until it comes in contact with the soft palate and closes the naso-pharynx. In some children this congested condition becomes sufficient to produce an obstruction of the nasal tract when lying down only. The mass of lymphoid tissue mentioned above is only a part of a continuous ring that encircles the pharynx, and is known as the ring of Waldeyer. Owing to the ease with which this ring of lymphoid tissue becomes infected it is also known as the vicious circle. The enlargement of the mass of lymphoid tissue in the naso-pharynx posterior and above the soft palate,

Fig. 167.

Fig. 168.

Figs. 167 and 168.—Facial deformity caused by mouth-breathing.

can only be seen by the use of reflected light and a pharyngeal mirror. However, the clinical picture of the patient is enough to prove the presence of adenoids to one familiar with the conditions. The patient has a "vacant stare" which is better described as follows: the upper lip is short; the external nares undeveloped; lack of development through the nasal region; antral cavities are undeveloped, which gives a narrow face; mandible underdeveloped; poorly developed chin. The eyes often appear large and staring, which is the result of lack of development of the nasal regions. Figs. 167 and 168 show the appearance of a patient who is a mouth-breather as the result of adenoids. Patients suffering from this condition all present the same picture. Figs. 169 and 170 show a case somewhat older. As these patients grow

older, the condition becomes more marked and in adults the deformity is great (Figs. 171 and 172).

Owing to mouth-breathing, air does not pass through the nasal cavities, and as a result no pressure from the air during inhalation and

Fig. 169. Fig. 170.

Figs. 169 and 170.—Facial deformity of older patient caused by mouth-breathing.

Fig. 171.

Fig. 172.

Figs. 171 and 172.—Facial deformity caused by mouth-breathing.

exhalation is exerted upon the walls of the nose. The relation of the bony walls of the nose is shown in Fig. 173, made from an embryo at birth. At this age the maxillary sinus is not seen and the roof of the

mouth is nearly straight. The inferior turbinated bone lies close to the floor of the nose. If the child breathes normally, the nasal cavity will develop, the floor of the nose will be carried downward and the septum will have room to grow. The growth of the nasal cavity affects the growth of the maxillary bone, and likewise anything which affects the growth of the maxillary bone will influence the oral cavity. Fig. 174 shows the maxillary bones, and it will be seen that about three-fourths of the lateral walls and four-fifths of the floor of the nose is made up of the superior maxillary bones. It is therefore easy to understand how the

Fig. 173.—Shape and relation of nasal cavity and roof of mouth at birth. Note absence of maxillary sinus.

lack of development of the nasal cavity will influence the maxillary bone and how the lack of growth of the maxillary bone will influence the nasal cavity. As the child grows, the nasal cavity increases in size and grows downward and outward until in the adult we find conditions as shown in Figs. 22 and 175, the force of air pressure during breathing acting as a force to cause the normal development of the nasal and oral cavities. Muscular pressure also plays an important part. In normal breathers,

the mandible is held in place by atmospheric pressure. When the mouth is closed, one usually swallows, which brings the tongue up against the roof of the mouth and causes it to fill the whole of the oral cavity. As a result of the tongue occupying this position, pressure is exerted on the lingual sides of the upper and lower teeth, which forces them buccally. In mouth-breathing, the tongue does not exert any force on the upper teeth, which allows the upper arch to remain undeveloped, and it is therefore spoken of as a narrow arch. The tongue lies in the lower part of the oral cavity and does not touch the lower anterior teeth. The mandible drops downward as a result of the loss of atmos-

Fig. 174.—Maxillary bones, showing large amount of nasal cavity formed by maxillary bones.

pheric presure and the muscles that depress the mandible hold the mandible from developing forward, owing to the weight that they exert on the anterior part. As the mouth is held open, the molars are separated enough to allow the mandibular molars to lock distal to the upper molars. If mouth-breathing occurs early in life, we find the deciduous teeth as shown in Fig. 176, which makes distoclusion with labioversion of the maxillary anterior teeth, or Class II, Division 1, the prevailing type. If mouth-breathing occurs after the locking of the first molars, and the cusps of the teeth are long, we find such cases as are shown in Fig. 38.

As the action of the muscles is abnormal, the upper lip does not exert pressure on the maxillary anterior teeth, thus allowing them to protrude. With the open mouth and parted lips, the lower lip drops

Fig. 175. Relation of nasal and oral cavities in the adult. Compare with Fig. 173.

back against the mandibular teeth and then the upper portion of the lower lip exerts pressure on the lingual surface of the maxillary teeth, as shown in Fig. 177. The irritation of the maxillary teeth causes the lower lip to become thicker, which in turn causes the maxillary teeth to protrude farther.

Enlarged Tonsils

Associated with the enlargement of the lymphoid tissue in the nasopharynx is the enlargement of the lymphoid tissue in the oral pharynx, commonly called tonsils. These masses of tissue are located on the right and left sides of the oral pharynx at the base of the tongue,

Fig. 176.—Malocclusion of deciduous teeth caused by mouth-breathing.

Fig. 177.—Showing abnormal muscular pressure associated with mouth-breathing. (Pollock.)

between the anterior and posterior pillars of the fauces. The tonsils often become inflamed and are the source of much annoyance. As they are enclosed in a capsule and contain a considerable amount of

connective tissue, the tonsils are quite painful when they become inflamed, in which respect they differ from adenoids. Many times the tonsil becomes chronically inflamed, and when in that state often is the beginning of mesioclusion, or Class III cases. Owing to the inflamed tonsil, the child protrudes the mandible, which produces more space between the pillars of the fauces and consequently relieves the pressure on the inflamed tonsil. As a result of the protruded mandible the teeth are locked in an abnormal position. As the muscular action that moved the mandible forward is relinquished, the mandible drops back to its normal position, but as the teeth are locked in an abnormal relation they remain in that position and malocclusion results.

Habits

Habits of childhood produce a few types of malocclusion. Thumb-sucking and finger-sucking have long occupied a place among the etiologic factors of malocclusion, but they do not produce as many malocclusions as was formerly supposed. There are a few cases that are produced by lip-biting and lip-sucking, also others which are produced by tongue habits. This type of cases becomes very troublesome to treat unless it is possible to break the patient of the habit.

Sore Teeth

Very often the decay of a deciduous tooth will cause the child to masticate in such a manner as to miss that tooth, with the result that the mandible will be thrown to one side. This will permit some of the teeth to lock abnormally when they are erupting and thus furnish the starting point of a severe malocclusion.

In certain cases, other conditions will be found to play a part in the production of malocclusion. Each case must be studied carefully and every effort made to find the etiologic factor that has been responsible for the deformity.

CHAPTER V

REGULATING APPLIANCES

Principles of Regulating Appliances

Regulating appliances are mechanical devices for the purpose of exerting force upon malposed teeth, in turn creating cell activity and thereby causing the teeth to assume a proper position in the line of occlusion. It is necessary that the operator has a proper conception of what the regulating appliance is for. The appliance must be viewed from three distinct angles. *First,* it is a mechanical device for exerting force upon malposed teeth, which is the necessary feature. If the appliance is mechanically imperfect and does not exert the pressure upon the proper teeth, failure will result. The *second* and equally important point is the purpose of the appliance, which is to exert force upon the malposed teeth to "create cell activity." After the cell activity occurs, the *third* factor of the appliance is manifested, which is to exert pressure on the malposed teeth and guide them into their proper position. The mere exertion of force upon the teeth is not enough to cause them to assume the position in the line of occlusion that they should occupy. It is true that teeth have been moved and can be moved by the application of a great amount of force and such movement occurs too often, but the movement is not physiologic and those who use such methods are not practicing orthodontia. They are only moving teeth and causing much suffering to their patients.

Requirements of Regulating Appliances

In the definition of appliances, we state what the appliance is for and what it must do, which are the essential features of any appliance. However, there are requirements that appliances must possess and some appliances are better suited to do certain things and correct certain types of malocclusion than others.

Efficiency.—Efficiency might be named as the first essential feature, which means that the appliance should do the work for which it was devised. This may seem like an extravagant statement, yet formerly appliances have been invented that were not suited to do the work intended. It is possible to exert force on teeth with very crude and

unscientific devices and accomplish some results. However, when we speak of efficiency, we mean that the appliance should accomplish the desired results without waste of time or energy. The appliance should be so made that it will follow certain mechanical principles that have been proved effective in other devices. After the appliance is constructed along the proper mechanical lines which make it an efficient device, this efficiency may be lost and destroyed by insecure attachments of the appliance, either to the malposed tooth, or to the anchor tooth. As example, the jackscrew is an efficient appliance so far as the mechanical device is concerned, but in a great many cases, the efficiency has been lost, because of insecure attachments. There must be some means of attaching the appliance to the teeth to be moved so that it will be possible to exert the required amount of force and in the proper direction. The appliance must be attached to some point that is known as the anchor tooth, or we may say that the appliance must possess sufficient anchorage. As anchorage is one of the essential features in the efficiency of appliances, it will be described under a separate heading.

Durability.—The appliance must be so constructed that it will be capable of use during the entire operation. It should be of such material that it will be little affected by the fluids of the mouth, and of such design that force can be exerted upon any or all of the teeth at the same time and in similar or opposite directions. By having such an appliance it is not necessary to subject the patient to the fitting of several different appliances before the case is completed. It saves much time for the operator and accomplishes the result in the shortest possible time.

Cleanliness and Antisepsis are properties which go together to a certain extent. It must be possible for the patient to keep the teeth clean, which can only be accomplished when the appliance is constructed with that idea in view. For example, round appliances are more easily cleaned than flat appliances, for there is not so much of the appliance in contact with the teeth. All bands must be cemented on to prevent anything getting between the teeth and the bands. The use of cement is for prophylactic measures. In regard to aseptic appliances, the material out of which the appliances are constructed plays an important part. Some alloy that contains an amount of copper or zinc is more aseptic than gold or platinum. The use of some of the non-corrosive alloys offers the advantage of being aseptic and at the same time presenting a good appearance in the mouth.

Simplicity is another characteristic that must always be considered. All mechanical devices are more useful as they approach simplicity.

In fact, the only perfect mechanical devices we have are those that have eliminated all superfluous parts until nothing remains that does not perform some definite function. The tendency in modern regulating appliances is to eliminate all parts that do not add greatly to the value of the appliance. Appliances should be constructed so as to get the greatest number of principles without increasing the bulk. Many devices constructed in former years have failed because simplicity was neglected.

Inconspicuousness is a feature that is considered only for the satisfaction of the patient. This essential is one that the patient is always considering and often the success of the practitioner will depend upon his ability to make the appliance inconspicuous. If cleanliness. aseptic properties and simplicity have been considered as they should be, inconspicuousness will generally follow. Still, many appliances that are conspicuous in the hands of some operators look well and are little seen when used by others. Experience has shown that the expansion arch, which is the most universal fixed appliance, can be made inconspicuous if properly applied and at the same time will be just as efficient as if it were used otherwise. In no case must efficiency be sacrificed for inconspicuousness, as when we are often requested by the patient to place the appliance lingual to the teeth. Experience has proved that a lingual appliance is less conspicuous than a labial appliance, but in using a lingual appliance. the operator must be able to accomplish results with it that will be equally as effective as the labial appliance. Efficiency must not be sacrificed for inconspicuousness.

Fixed and Removable Appliances

Regulating appliances are divided into fixed and removable. Fixed appliances are those that are placed on the teeth in such a manner that they can only be removed by the operator. Removable appliances are those that are attached to the teeth in such a manner that they can be removed by the patient.

Fixed Appliances have the advantage of firm attachment both to the moving teeth and to the anchor teeth. As it is firmly attached the appliance can be of smaller size than if of the removable variety.

The fixed appliances may be divided into the labial and lingual arches. The labial arch, when used as an ordinary expansion arch, is very conspicuous and less cleanly than the removable appliance. The same objection holds true in regard to the pin-and-tube appliance, the ribbon arch, and similar appliances. The lingual arches are very

inconspicuous and cleanly and offer many advantages that are not possessed by the labial arch. They have firm attachments and cause little inconvenience to the patients.

Removable Appliances are recommended because of the fact that they can be removed by the patient and the appliance and teeth thoroughly cleaned after each meal. They are less conspicuous than the fixed labial appliances, but have the disadvantage that they are not securely attached to the moving teeth or to the anchor teeth, which limits their use in some of the complicated cases of malocclusion. The simpler forms of malocclusion can be treated with the removable appliance, but there are a large number of cases in which the results obtained by the fixed appliance are better than the author has ever seen from the treatment of similar cases by the removable appliance. One of the great advantages of the removable appliance, namely, that the patient can remove it, becomes a disadvantage in the mouths of some patients.

Technique for Making Regulating Appliances

Various forms of fixed devices have been placed on the market and used at different times, some of which have become obsolete. It is the author's intention to consider only those that have a place in modern orthodontia, those that he has found of advantage and those that are employed by the majority of men who are devoting their entire time to the practice of orthodontia.

Bands

Bands form one of the principal parts of the fixed appliance. Bands are divided into plain and clamp (Figs. 178 and 210). A plain band is made by pinching or burnishing a piece of metal around the tooth

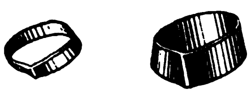

Fig. 178.—Plain, or Magill, bands.

to be banded or around a model of the same and soldering the ends together. The size of the band is not adjustable. They are made and used on all of the teeth, but the best fitting bands are made on the six anterior teeth. Plain bands can be made for molars and premolars that fit very accurately if the proper technique is followed.

Which form of plain band was first used, or the inventor of same, has never been known. They did not meet with universal use until the introduction of cement. The use and making of the plain band as most employed today was introduced by Magill, and is known in literature as the "Magill band."

Composition of Appliances.—The band may be made out of various materials, namely, gold, gold and platinum, iridio-platinum, nickel silver, and aluminum-bronze. There are several alloys on the market sold under various names which are said to possess certain desirable qualities. These alloys are probably aluminum-bronze. The "non-corrosive material" sold by some manufacturers makes a very desirable material. Each one of the various materials used for plain bands has its advantages and disadvantages.

Gold, which was probably used first, is recommended for its ease of manipulation and for its color. It does not tarnish easily in the mouth, although in some instances it does discolor greatly. One of the disadvantages of gold is the lack of strength when rolled thin enough to permit its use without causing great separation of the teeth. Also, if appliances are attached to gold bands and considerable force exerted upon the appliances the gold will tear. Still, the greatest disadvantage to the use of gold is that it possesses no antiseptic property. Alloys of gold to form what is known as clasp metal have been used which eliminate some of the first objections, but the last one still remains. Gold and platinum material, composed of equal parts of gold and platinum, makes an alloy that is strong, can be rolled thin and has a nice appearance, discolors in some mouths, and is not antiseptic, that is, does not retard the growth of microörganisms. On account of the last-named objection it is little used by the author.

Iridio-platinum is a material much used by some practitioners, and is very strong even when rolled thin. It is seldom necessary to use it more than .005 or 36 gauge and some cases will possess sufficient strength when used .003 or 40 gauge. It melts at a high degree of temperature and can be soldered with pure gold. This leaves little danger of the opening of the solder-joint when other solder attachments are being made to the band. Also, the joint will not open under stress as sometimes happens when a low karat solder is used. Iridio-platinum discolors in some mouths and like the other noble metals does not retard the growth of microörganisms. A tooth that is in contact with an iridio-platinum appliance is very liable to decay; in fact it seems as if the tooth is more apt to decay than not. As a result of the use of this material, many caries have been caused that would not have been pro-

duced otherwise. Owing to the great strength of iridio-platinum, it is the most satisfactory of all the band materials from a mechanical standpoint. It is quite stiff, which makes it more difficult to work than some other materials, but when properly adapted to the tooth, the stiffness becomes a mechanical advantage as it will stand the stress of mastication without the occlusal edge bending as often occurs in softer band materials. The stiffness of the band material is also an advantage, in forcing the band between teeth that have a tight approximal contact. Also in an iridio-platinum band if properly contoured, the stiffness will enable the band to be so shaped that it will pass over the tooth with a snap and hug the contour of the tooth on the mesial and distal sides which will not occur with the use of a soft band material. Realizing the fact that iridio-platinum has no antiseptic properties, it becomes more necessary in the use of iridio-platinum that the band be made anatomically correct, so as to enable the patient to keep the bands and appliances properly cleaned and therefore prevent decay. The lack of antiseptic properties in iridio-platinum is the most objectionable feature it possesses, and one which must always be kept in mind in using this material. Because of the large mechanical advantages it possesses, it is probably the most ideal band material from a mechanical standpoint.

Nickel Silver has been used in the past in the making of appliances to a greater extent than any other material. Various metals are used in alloying of the material, generally some percentage of nickel, copper, tin or zinc being employed, each manufacturer having his own combinations. The great advantage of nickel silver lies in its strength, as it is much stronger than gold, and even when rolled thin and made pliable by annealing, it will not stretch. It can be soldered with a high karat solder, as the melting-point is higher than low karat golds. It takes a high polish and in some mouths holds the color well. Nickel silver can be easily gold-plated, but in those mouths where discoloration occurs the plate does not last long. It always corrodes and is affected by the fluids of the mouth. Pits will form in the bands and in some cases after six months to a year deep pits will form, which finally perforate the band. This limits the time during which a nickel silver band can be left in the mouths of some patients. In spite of all these objections nickel silver has an advantage that is not possessed by the metals above mentioned, namely, its antiseptic properties. This metal will discolor and the teeth become black, but there is less liability of the occurrence of decay than if the appliance were not there. The author much prefers, to a metal that invites caries, one that discolors but that can be kept clean with a reasonable amount of care, and one that re-

tards the growth of microörganisms and decay in those mouths where there is a predisposition to caries.

The objectionable characteristic of nickel silver—its tendency to discolor—was taken up by a number of manufacturers with the result that several metals were placed on the market that probably should be called aluminum-bronze. The author has never employed aluminum-bronze under that name, but for the past six years has used the non-corrosive metal as sold by the various dealers, and he finds that it has all of the advantages of nickel silver; is germicidal, easy to work, can be made extremely pliable but is slightly more difficult to solder. The metal is more yellow than nickel silver and in some mouths turns the color of gold. It will discolor to no greater extent than gold, gold and platinum or iridio-platinum. In some mouths the bands have a tendency to pit, but this is a slight objection, which is more than offset by the germicidal action.

Most of the materials above mentioned can be bought in any suitable width and thickness. Gauge 36 or .005 is the most ideal thickness for all purposes. For the molar bands a thicker gauge may be used and for the anterior teeth one that is thinner may be employed.

Whatever material is employed must be well annealed before being used.

Band Technique.—Bands can be made by the direct or indirect methods. The direct method consists in making the band over the tooth by pinching and burnishing a piece of metal to fit the tooth and then soldering the ends of the band together. These bands are classified as *pinch bands*, which are made by pinching the end of the material together and then soldering the pinched ends; or *lap bands*, which have the end of the material lapped over and soldered together. The indirect method consists of making the band over some form of model, which may be a plaster model or a metal model. Metal models are made out of low fusing metals, Babbitt and Malotte's metal and such, or from amalgam.

Direct Band Technique.—The seam of the band that is the soldered joint, can be placed on the lingual or labial side of the tooth. This is decided by the occlusion of the teeth and what other attachments are to be placed on the band. It is more convenient to make the seam on the labial side, and unless there is some very good reason for not doing so, that side is always chosen.

In making a band for the upper incisor, it is seldom necessary to separate the teeth previous to making the band. By using a 38 gauge material it can generally be passed between the teeth. A piece of band

Fig. 179.—Angle's band-forming pliers.

Fig. 180.—Angle's soldering pliers.

material slightly longer than is needed for the band is passed between the teeth and the lingual portion is burnished close to the tooth. Traction is made on the free ends of the band material and while this is being done the labial portion is made to conform to the tooth by plier beaks, the edges of which come close together. For that purpose there

are several forms of pliers on the market, known as band-forming pliers. Those designed by Angle are shown in Fig. 179. Case and Pullen have also designed excellent band-forming pliers. After the band has been pinched so as to conform close to the teeth at all points, it is soldered by holding the material with a pair of soldering pliers, made of some material that conducts heat poorly, and the points are bent at right angles (Fig. 180) so as to conduct little heat away from the band. A little flux is placed on the inside of the seam (or joint), and when heated to the proper degree, a piece of solder in wire form is touched to the seam. The use of a solder, either silver or gold, in wire form will be

Fig. 181.—Using solder in wire form.

found to be a great convenience, and is used as shown in Fig. 181. In making these bands it is necessary to have a blowpipe which can be at all times under the absolute control of the operator and still leave both hands free. After giving every blowpipe and method a fair trial, the author has reached the conclusion that the best results can be secured with the Herpath or Lane pipe, the air supply coming from the mouth blowpipe. There is no objection to compressed air, but the author has secured better control over his flame in the "old-fashioned way." Plain bands on the incisors should be placed as far gingivally as possible without infringing upon the gums. As a rule the author does not festoon the band, but leaves it the same width the entire circum-

band. Any band is only as strong as
ontists trim the band so that it follows
tooth. Others trim it on the approxi-
fere with the approximal contact, which
nd. Various attachments are placed on

with lap seam, some measure of the
greatest circumference. This measure-
ng the thin copper strips that are used
and are on the market as the Hollings-
ese strips is pinched around the tooth
inch band is made, and a strip of band
h sufficiently longer than the measure-
lap the ends. The ends are then sol-

following technique for making lap

king, showing pieces of metal between teeth and ap-
ed with moldine. (Schroeder.)

A piece of band material is carefully
the ends drawn with the fingers while
l on the lingual side. The material is
nd distal portions of the band material
d distal contact points, or the points of
ncave by using contouring pliers that
vex beak. The band material is again
banded, and it will be found that the
h closely on the mesial and distal sides,
s been produced by the use of the con-
w tightly pinched by the band-forming
of the band material is now cut off at
ther end is straightened out and cut off
nark to leave enough lap to solder. The
r with a high-fusing solder, and should
r attachments to the band in the region

of the seam, they can be made by using a lower fusing solder or by holding the seam together with a pair of soldering pliers while the piece is soldered to the band. If any attachment is to be made to a band that will require the exertion of much force on the attachment, either from occlusion or from the appliance, it is an advantage to make the attachment on the lap seam, as this is the strongest part of the band.

Indirect Band Technique.—The first step in indirect band-making is to secure an impression from which to make the model of the tooth. A plaster impression of the tooth to be banded is obtained, and it will necessarily include the approximating teeth. The approximating teeth are filled with moldine, and the moldine is built up on the mesial and distal side of the impression of the tooth to be banded and around the buccal and lingual gingival margin in such a manner as to increase the length of the crown of the tooth when the metal model is made (Fig. 182). This building of moldine around the gin-

Fig. 183.—Metal models of single teeth. Models of anterior teeth made with strip of metal between teeth. (Schroeder.)

gival margin of the impression makes possible a metal tooth that has the gingival margin exposed so that the band can be fitted. The filling of the approximating teeth with moldine eliminates them from the metal models and leaves only the tooth to be worked on, without the interference of any approximating teeth. If a model is to be obtained of the anterior teeth, incisors, and canines, an ordinary plaster impression is obtained of the mouth, and in removing the impression, it is broken in as few pieces as possible. The impression is waxed together and every other tooth filled with moldine, and then the impression is poured with Melotte's metal. The plaster impression is carefully removed from the metal model, care being taken to avoid breaking the impression into many pieces. The moldine is removed from the impression of the teeth, the impression is again placed together, and moldine is placed in the impression of those teeth from which the metal models were made the first time. The impression is

Fig. 184.—Thin copper band trimmed to festoon of gum.

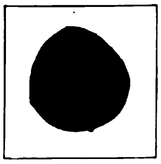

Fig. 185.—Impression of tooth in compound.

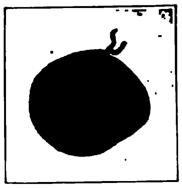

Fig. 186.—Impression with celluloid strip wrapped around it.

Fig. 187.—Impression invested in plaster.

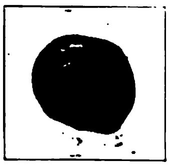

Fig. 188.—Copper amalgam model of tooth.

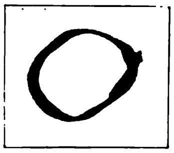

Fig. 189.—Band soldered with lap joint.

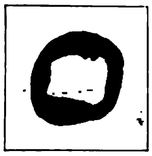

Fig. 190.—Band swedged.

Fig. 191.—Cusp swedged for band.

Fig. 192.—Band with cusp soldered and cut out for occlusion.

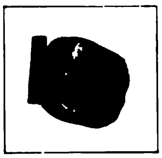

Fig. 193.—Crown with tube and lug.

(Coston.)

again poured full of Melotte's metal and we now have a model of the remaining anterior teeth. We now have all of the anterior teeth reproduced in metal, bands can be made over them, the necessary attachments made, and the appliance tried on the model. The metal molars and a part of the anterior teeth will be on one model, which will enable the operator to make and adjust all appliances over the models. This plan of making a metal model was shown the author by Dr. Hoggan. Another plan of taking a plaster impression, from which a metal model of incisor is made, is to place band material between the teeth before the impression is taken. These pieces of band material remain in the impression and when the metal model is made, the pieces of band material are removed, which leaves sufficient space between each tooth so the band can be fitted, and each tooth has the proper mesio-distal diameter. (Fig. 183.)

Amalgam models are made from copper amalgam by taking an

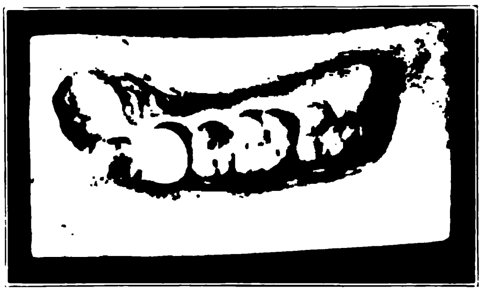

Fig. 194.—Plaster model for use in indirect band-making. (Mershon.)

impression of the tooth in modeling compound. Separating wires are placed on the mesial and distal side of the tooth in order to produce enough separation so that a piece of nickel silver or thin copper can be roughly fitted around the tooth and the ends soldered together (Fig. 184). The mesial and distal gingival borders are festooned so as not to interfere with the gum, and the buccal and lingual portions of the band must come well gingivally on the buccal and lingual side of the tooth. This gives us a band of nickel silver or copper that is slightly larger than the tooth and about twice the length of the crown of the tooth. This band is to serve as an impression tray and is filled with modeling compound and forced over the tooth (Fig. 185). This gives us an impression of the crown of the tooth that is as accurate as is possible to obtain. In order to increase the length of the gingival portion of the impression and to give a

base to the amalgam tooth, a piece of celluloid is wrapped around the impression (Fig. 186). This impression is then invested in plaster in order to give a firm base in which to pack the copper amalgam (Fig. 187). Copper amalgam is then packed into the impression, and after

Fig. 195.—Model with tooth trimmed for indirect band technique. (Mershon.)

Fig. 196.—Buccal view of model for indirect band technique. (Mershon.)

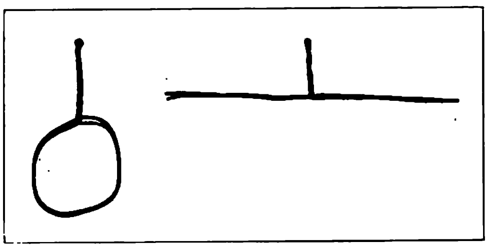

Fig. 197.—Wire measurement of tooth shown in Figs. 195 and 196. (Mershon.)

it is hard the plaster is broken apart and the metal tooth removed (Fig. 188). Around this metal tooth a band is made, with either a lap joint or a pinch joint. The lap joint is the better, owing to the fact that this band is to be swaged, as are all bands that are made

over single metal teeth. The band is fitted to the metal tooth and placed in a crown and bridge swager of the plunger type. A rubber disk, moldine or warm modeling compound may be used as the swaging material. The band, after being swaged, is shown in Fig. 190. On deciduous molars and teeth that are badly broken down, a cusp (Fig. 191) can be swaged over the amalgam tooth and attached to the band, which will give a crown that will offer more adhesion to the

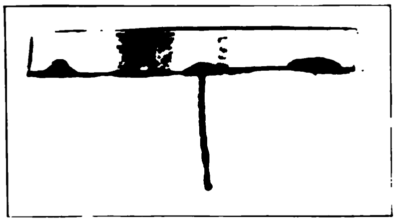

Fig. 198.—Wire measurement laid on band material. (Mershon.)

cement and afford better protection to the tooth. If, after cementing the band in place, the cusp portion interferes with the occlusion, the interfering parts can be ground off, leaving the band as shown in Fig. 192. Fig. 193 shows the buccal tube attached to the band. It will be noticed that there is a small piece of wire soldered on the lingual side of the band, which is for the purpose of catching an instrument under the band to remove the band from the tooth, in case

Fig. 199-A.—Band material with ends lapped. (Mershon.)

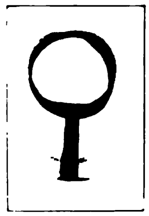

Fig. 199-B. — Band soldered. (Mershon.)

the band is put on the tooth before being cemented. These swaged bands fit more accurately than bands made by any other method. They go on the teeth with a snap and are very difficult to remove even if not cemented on the teeth. Bands that are made over metal models can also be adapted by the use of a horn mallet in the same manner that metal plates are worked over a metal die. Bands can also be made by the indirect method over plaster teeth. A modeling compound impression is taken of the teeth on one side only in order to

avoid drawing of the compound. A model so made is shown in Fig. 194. With a small saw, the teeth on the proximal sides of the tooth to be banded are cut away and the model trimmed as shown in Figs. 195 and 196. A wire measure is then taken of the plaster tooth as shown in Figs. 195 and 196. This measure is taken at the point of greatest circumference and is twisted tight around the tooth, and then the ends are pulled and given one-quarter or one-half more of a turn. The wire measure is then removed and cut as shown in Fig. 197.

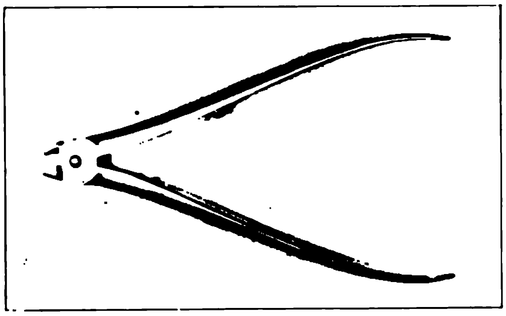

Fig. 200.—Mershon's band-stretching pliers. (Mershon.)

The measure is then laid on a piece of band material as shown in Fig. 198, the ends of the band material having been cut on a bias. The wire measure is placed on the wide portion of the band material and a scratch is made at the end of the wire measure. The band material is cut about 8-100 of an inch longer than needed, so as to allow for the overlapping ends. The ends are overlapped far enough to cover

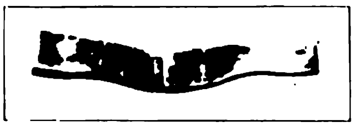

Fig. 201.—Band cut to show effect of contouring and stretching. (Mershon.)

up the scratch on the band material, for it is desired that the band be made slightly smaller than the measurement. Fig. 199-A shows the end of the strip of band material overlapped preparatory to soldering. Fig. 199-B shows the edges of the band material soldered together. The band is then shaped to the tooth. In attempting to place it on the tooth, it will be found to be too small, owing to the fact that the occlusal part was made smaller than the measure. By carefully noting where the band binds, it can be removed and pinched with

the band-stretching pliers and again tried on the tooth. The band will now go on farther than it did before it was stretched. By repeating the trying on and stretching process, the band can be made

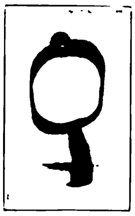

Fig. 202.—Band with half-round tube attached. (Mershon.)

to fit the plaster tooth very accurately. The gingival edges on the mesial and distal portions are trimmed to avoid injury to the gum

Fig. 203.

Fig. 204.

Figs. 203 and 204.—Band fitted to model of maxillary molar. (Mershon.)

tissue. The stretching pliers are shown in Fig. 200. After the band has been stretched and trimmed, it will fit the convexities of the tooth very accurately. If a band so shaped is cut opposite to the

seam, the band material will have assumed a shape as shown in Fig. 201.

In making a band after the above technique, the seam on the band for the lower molar is placed on the buccal side, and on the band for the upper molar is placed on the lingual side. This is because of the convexity of the respective surfaces of the maxillary and mandibular molars. After the band has been fitted to the model, whatever attachment is necessary is placed on the band. Fig. 202 shows a half round spur that is placed on the band for use with the removable lingual alignment wire. If a buccal tube is required, it can also be

Fig. 205.—Manner of holding wire to make spur on plain band.

used. Owing to the fact that the band is made with a lap seam that is soldered with a high fusing solder, the tubes or any other attachment can be made directly over the soldered seam. Any possibility of opening up of the seam can be avoided by holding the lap ends of the seam with a pair of soldering pliers the ends of which are bent at right angles.

Fig. 203 shows the lingual side of a band fitted to the model of the upper molar. Notice how the lingual side follows the convexity of the lingual surface of the upper molar. Fig. 204 shows the occlusal view of the same tooth.

Soldering Technique.—A small spur is soldered on the band for rotating teeth and is made as follows:

The spur should be attached at a point far enough gingivally so that the ligature will pass above the gum and below the approximal contact point, and slightly to the side toward which the tooth is to be rotated. A piece of wire of 18 or 20 gauge is selected and the end filed to an angle of 45 degrees. The band is held in the pliers and the solder flowed at the point to which the spur is to be attached. This is done by heating the band and touching it with the wire-solder when it reaches the proper heat. A little flux is placed on the wire

Fig. 206.—Manner of holding small tube on ligature wire while soldering same to band.

and then by holding the piece as shown in Fig. 205 the wire is soldered to the band. The wire is then cut off making a spur about one and a half times as long as the thickness of the ligature-wire, or ligature that is to be used. In place of the spur, Brady has suggested the use of small tubes soldered well toward the gingival portion of the band, through which the ligature is passed. When threaded through the tube, the ligature will be prevented from coming off if it should in any way become loose on account of the tooth moving a great deal between visits. Care must be taken in soldering the tube to the band to prevent the solder from flowing into the tube and closing it. It is held and soldered to the band as shown in Fig. 206.

The plain band is also used when the perpendicular tube is employed in the bodily movement of teeth as suggested by Angle. In those cases the seam of the band is generally made on the lingual side as a matter of convenience.

The making of the canine band is more difficult owing to the pointed shape of the tooth. A piece of the band material is placed between the teeth and traction is made on the material. It will be seen that the occlusal portion of the material on the lingual side stands away from the tooth. While traction is being made on the ends of the band material, the lingual portion of the material is pinched with the band-forming pliers, making a pinch as shown in Fig. 207. The material is then removed from the tooth and flux is placed on the lingual portion of the pinched band material and heat is applied and the band is touched with the solder at the proper time. It will now be found that the lingual portion of the material fits the canine accurately. The mesial and distal part of the band material that will be against the con-

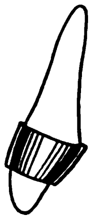

Fig. 207.—Band pinched on lingual and labial sides.

vexity of the mesial and distal portion of the tooth should be made con vex, after the method suggested by Mershon, by using a pair of contouring pliers that have a concave and convex beak. After the mesial and distal sides are made concave, with the concavity toward the center of the band, the material is placed around the canine and the pinch is made on the labial side. If a pinch band is to be made, it is soldered in the usual manner, and if lapped, the same technique is employed as described in the description of making incisor bands.

In making plain bands for the premolars and molars, it is best to slightly separate those teeth, which enables us to get the material between the teeth more easily and also to secure a better fit, which is greatly to be desired, for it will require long experience before one is able to make a plain band on the molars and premolars that will in any manner nearly approach the neatness of the anterior bands. The best method of producing separation is to take a piece of ligature

wire of about 26 gauge and pass it between the teeth gingivally to the proximal contact point and bring the end occlusally to the contact point and twist the ends together. The twisting of the ends exerts pressure upon the teeth and slightly separates them. One of these wires should be placed on the mesial and distal side of the tooth to be banded. Some have suggested the tying of silk ligature or traction cable in the same manner as the wire ligature is placed, but the author does not like it so well, for it becomes filthy and often makes the proximal gum tissue sore. The wire ligature will produce sufficient space in twenty-four hours, but no harm will result if left a longer time. In making a band for a molar or premolar, the material is passed around the tooth and the pinch is made at the mesio-buccal angle so as to bring the seam as near the proximal contact as possible. This places the soldered part of the band out of the way of the cheek. As the gingival part of the permanent molars and premolars is of a smaller diameter than that part at the contact points, care must be exercised not to pinch the band too tightly at the gingival

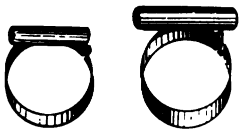

Fig. 208.—Plain molar bands with tubes.

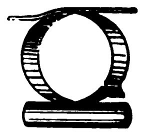

Fig. 209.—Plain band with lingual bar.

Plain bands are fitted and contoured to the tooth.

portion or it will be impossible to get the band on the tooth after it is soldered. After the band is soldered it is then placed on the tooth, and if made for the premolar, the mesial and distal occlusal margins are burnished into the mesial and distal parts of the central fossa. If made for a molar, the disto-occlusal part is burnished into the distal part of the central fossa of the lower molars and into the distal part of the disto-lingual fossa of the upper molars. This prevents the band from being forced too far gingivally, should the cement become loosened between visits. It will usually be necessary to make a pinch on the linguo-occlusal margin of the upper molars so that the band will fit the convexity of the lingual surface. A pinch is often made on the buccal side of the lower molar for the same purpose.

When this band is made to be used as an anchor band with the expansion arch, the band is placed on the tooth after it has been burnished and the pinches soldered, and a scratch is made on the buccal side showing the proper direction in which the tube is to be

placed. The seam of the band is held with a pair of pliers, the point of which has a groove of sufficient width to straddle the seam, and possesses a slide on the handle that holds the beaks together. With this form of pliers the band can be securely held, and should there be enough heat on the band to melt the solder, the seam will not open.

Solder is flowed on the buccal tube that is to be attached to the band, flux is placed on the band, and the tube soldered to the band at the proper place and in the proper direction. A band of this kind is shown in Fig. 208.

It is much easier to make a plain band for the deciduous molars, because the gingival margin of the teeth presents a diameter nearly as great as any other part. The band can be pinched tight around the tooth, and any free portion of the band that exists around the occlusal portion can be burnished and pinched to the tooth. All pinches are united with solder as was done in the canine bands. Plain bands on molars possess the advantage that they do not present any sharp portion on the lingual side, which is a great advantage in the case of children. In those cases in which the permanent molar region requires expanding and the bands are placed on the second deciduous molars, a lingual bar is soldered to the band to engage the first permanent molar and the first deciduous molar. This style of attachment is shown in Fig. 209.

Plain molar and premolar bands are also used in retaining appliances.

Adjusting Clamp Bands.—Clamp bands are made adjustable by means of a screw attachment. There are two kinds of clamp bands, those with the clamping device on the lingual side and those with the clamping device on the buccal side, as shown in Fig. 210. Each style of band has advantages that will be taken up separately. Clamp bands are made out of German silver, "non-corrosive" metal "aluminum-bronze," gold and platinum, and iridio-platinum. The author prefers the band made out of a "non-corrosive" alloy that contains some copper.

The clamp band with the clamping device on the lingual side, which was and is a part of the "Angle appliances," makes the strongest and best fitting clamp band known. It is adjustable to all cases and by changing the angle and position of the tube, which is in no way a part of the clamping device, has a universal use. It is now made by different manufacturers in two forms, contoured and non-contoured. In order that a contoured band be of the greatest service it must be made for the right and left upper molars and for the right and left lower molars. A band that is contoured is also usually festooned,

which weakens the device. In other words, ease of adaptability is obtained at the expense of strength, but in most cases the contoured band is strong enough. The non-contoured band is universal—can be used on either the upper or the lower molars. It is contoured by the operator so as to fit the individual tooth. If the band is to be placed on the right upper molar, the screw should be bent so as to conform to the convexity of the lingual surface and the band contoured to the shape of the tooth. The gingival portion of the band should be contoured toward the center of the tooth so that the band will hug the tooth and pass under the gum and not infringe on the gingival tissue. The band should be placed about two-thirds of the way on the tooth and then tightened enough to make it conform to the tooth, which also makes the gingival portion hug the tooth closely. At this stage of the operation never tighten the band to its fullest extent or it will surely be ruined. Now loosen the band and push it on the rest of the way. If there is any pain in putting on a clamp band, the technique is wrong, or the band is so wide that it is infringing upon the gum tissue. If the band is too wide it should be trimmed slightly on

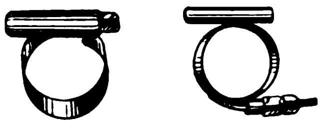

Fig. 210.—Clamp bands with clamping device on buccal and lingual sides.

both the occlusal and the gingival side, taking off a small portion around the entire band. Never trim the band only in the proximal part, for if that is done the band will be weakest at that point and probably tear. The object of trimming the band on both the occlusal and the gingival parts is to cause the screw to always pull from the middle of the band and to make the band draw evenly around the tooth. These bands are made of a material that is thin and tough enough so that they will stretch over the greatest convexity and pull into the concavities of the mesial and distal gingival parts. As the final tightening proceeds, the band is burnished to the teeth at all parts that can be reached with a burnisher.

In adjusting a clamp band, with the screw on the lingual side, care must be taken that the screw lies close to the lingual surfaces of the teeth. Also the flat side of the nut must always be toward the tongue; never leave the screw and nut projecting into the mouth. Greater care should be exercised in having the screw and nut in the proper place than in getting the tube to occupy its proper position, for the

tube can be unsoldered and placed at the required position, while the screw can not be so treated. If the screw is placed as suggested, it will produce little annoyance to the patient. A band placed on the teeth as described will stay without cement, but cement is used as a prophylactic measure only. A clamp band that depends upon the cement to hold it on the tooth is a poorly fitted or constructed band.

The second form of clamp band is one that has the clamping device on the buccal side. The idea of such a band is to avoid having any-

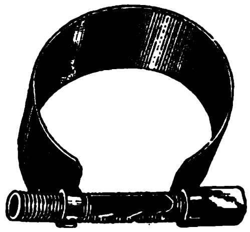

Fig. 211.—Band with clamping device and tube combined on buccal side. (Lukens.)

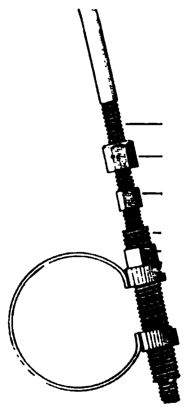

Fig. 212.—"Arlox" band designed by Dr. F. C. Rogers.

thing on the lingual side to annoy the tongue. The angle of the tube cannot be changed, thus limiting the use of the band in a great number of cases.

One form of this band is shown in Fig. 211. This type of band has been improved by Rogers by placing a locking device on the arch and band in such a manner as to add no extra bulk to the band, yet to lock securely the arch in the tube of the band. Fig. 212 illustrates such a band. In Fig. 212, *a* shows the screw tube on the band that has the

mesial end of the outside of the nut threaded (*b*) to receive the nut (*d*), which is large enough to slip over the nut (*c*), which is the nut on the alignment wire, and to screw on to the threads on the tube shown at *b*.

Ligatures

Ligatures constitute one of the important parts of the fixed appliance. Ligatures are of four kinds—wire, rubber, catgut, and silk, or grass-line. Of the last there are several kinds of ligatures on the market made by different manufacturers that are very nearly the same. They are made of a material that shortens under the action of mois-

Fig. 213.—Left central shows method of looping silk ligature to rotate distal corner of teeth labially. Right central shows how the ligature is then tied to arch to rotate distal corner labially.

ture and continues to exert a force on the teeth for a considerable length of time. The disadvantage of this ligature is that it becomes very filthy owing to the fact that it absorbs the fluids of the mouth. Great care must be taken to keep it away from the gum tissue, because inflammation will result if it should come in contact with the tissue at any point. These ligatures are found very useful in rotating teeth, for they can be used without a plain band. A loop is made and the ligature is doubled around the tooth, and then both ends are pulled tight and passed between the teeth and tied around the arch. Fig. 213 shows the manner of looping the ligature around the tooth, while the right central shows the manner of pulling the ligature between

the teeth and tying it around the arch. Just before pulling the ligature tight around the tooth, J. Lowe Young has recommended that one of the ends of the ligature be passed through the loop, making a wrap that will prevent the loop from loosing as the ends are being tied around the alignment wire.

Rubber Ligatures are really rubber bands. They have the greatest use in intermaxillary anchorage. If used on single teeth with intramaxillary anchorage, they exert too much force. These ligatures can be secured prepared for this purpose, or can be made by cutting pure gum rubber tubing (Fig. 214) the desired length and thickness. The length of the ligature can be varied by cutting straight across or on the bias. Fig. 215 shows a length of the rubber tubing and several ligatures all different lengths cut from the same tube.

Wire Ligatures, as introduced by Angle, are very useful with the

Fig. 214.—Rubber tubing from which ligatures of different sizes may be cut.

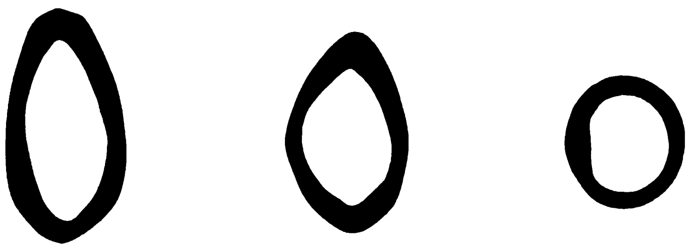

Fig. 215.—Three lengths of rubber ligatures cut from tubing shown in Fig. 214.

fixed regulating appliance that exerts both spring and screw force. The wire ligatures are generally of a tenacious variety of brass, although nickel silver, and iridio-platinum have been used by some. The requirements of a good wire ligature are: softness, so that it will be easily adaptable, and strength, so that it will not stretch when stress is placed on it. They are made in several sizes in order that they can be easily passed through the approximal space between the contact points and the gum. A ligature that is passed around the tooth and twisted, as shown in Fig. 216, is called a plain ligature. The wire that is on the distal side of the tooth should always be placed

gingivally to the arch, as there is greater danger of slipping off on the distal side than on the mesial side. If there is a great tendency for the ligature to slip off the tooth, the wire should be passed between the teeth on the mesial side of the tooth toward the lingual; brought toward the labial on the distal side of the tooth, occlusally to the

Fig. 216.—Showing plain wire ligature.

Fig. 217.—Wire wrapped around teeth before being put over arch to prevent ligature from slipping off.

arch; through on the mesial side, occlusally to the arch; and then out on the distal, gingivally to the arch. This makes a wrapping of the wire around the tooth that grips it tight, besides the two ends that pass over the arch. This plan of applying the ligature is shown in Fig. 217. When the wire ligature is used to rotate a tooth, a plain band that has a tube or spur soldered on it must be employed. Then the ligature is passed between the teeth above the arch, passed around the spur on the occlusal side and next brought through the approximal space below the arch. The reason for crossing the ligature on

Fig. 218.—Wire wrapped around arch in front of spur to prevent wire from slipping over spur.

the lingual side is that it grips the spur more securely. If a tube is used on the band instead of the spur, there would be no need of crossing the ligature.

When twisting a wire ligature it should always be toward the right, the same as a nut is tightened. This will be found very convenient, as it will not be necessary to look which way the ligature is twisted each time it is tightened.

Where spurs have been placed on the arch to prevent the ligature from slipping, the ligature should be passed below the occlusal side of the arch and the end brought up over the gingival portion, which makes one turn around the arch, and the end then passed between the teeth in the usual manner. This wrap (Fig. 218) around the arch prevents the ligature from slipping over the spur should the teeth move and the ligature become very loose. The manner of making spurs on the arches will be considered with arches.

Fixed Regulating Appliances

The main part of the fixed regulating appliance consists of some ›rm of the screw or spring lever. The force is the screw force and

the force of the spring. The two forces have been combined in the expansion arch.

The jack-screw, which was the first appliance placed on the market and constructed so that it could be used on different cases, has been made in many different forms. The best jack-screw consists of three pieces—screw, nut and tube. The object of the tube is to cover up the free end of the screw so that it will not (Fig. 219) annoy the

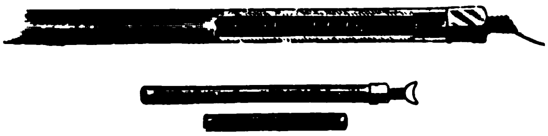

Fig. 219.—Angle's jack-screw.

tongue, and it also affords attachment for one end of the appliance. There are many different ways of attaching the screw to the teeth that are to be moved. The kind of anchorage that is used will determine what form of attachment is to be made. The advantage of the jack-

Fig. 220.—Angle's traction screw.

screw lies in the amount of force that can be exerted, the control of the force, and the firm manner in which it can be attached to the teeth. The disadvantage lies in the limited application of the device. The jack-screw exerts force only in one direction, and when a number

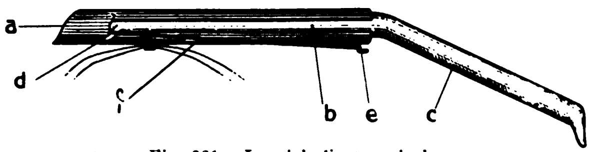

Fig. 221.—Lourie's ligature jack.

of different tooth movements have to be made, it becomes necessary to use many combinations of jack screws, making the appliance very complicated and bunglesome. The traction screw is only a modification of the jack-screw and is used for pulling (Fig. 220). It is very seldom that either of these appliances is used, as the improvement of the expansion arch and the use of the intermaxillary anchorage makes

it possible to treat cases more easily with the arch than with the jack-screw and traction screw.

A very ingenious and useful form of jack has been devised by Lourie, which is known as the "ligature jack." It embodies the principle of the traction cable, and the appliance is so constructed that the force of the silk ligature or traction cable is exerted between two points. It

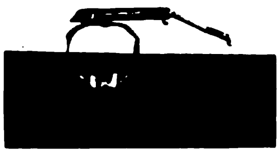

Fig. 222.—Ligature jack used with stationary anchorage. (Lourie.)

can be used for the expansion of the arch by pitting it against teeth on the opposite side of the arch or for moving a single tooth by the employment of stationary anchorage. It consists of a piece of heavy tubing (Fig. 221-*a*) of 19-gauge which has a longitudinal (*b*) 22-gauge slot cut in it and a piece of 19-gauge wire (*c*) to which has been soldered a spur of 22-gauge wire (*d*). A 22-gauge spur (*e*) is also soldered to the end of the tubing. A piece of traction cable (*f*) is tied be-

Fig. 223.—Ligature jack used to relieve impaction of third molar. (Lourie.)

tween the spurs *d* and *e* and as a result of the contraction of the cable, force is exerted on the tooth to be moved. The construction of the ligature jack for use with stationary anchorage is shown in Fig. 222. The appliance can be employed for elevating and straightening a molar, as shown in Fig. 223. As a reciprocal appliance for the widening of the arch it can be attached to the deciduous canines, as shown in Fig. 224. This principle can be used with the alignment wire in lengthening the lateral halves of the arch and can be made curved to fit the

anterior part of the arch in the incisal regions. The author is of the opinion that it is one of the most useful principles that has been given to us in the construction of appliances. It requires very little attention, and moves the teeth with no pain.

Fig. 224.—Ligature jack employed to widen maxillary arch. (Lourie.)

Alignment Wires or Expansion Arches

One of the principal fixed regulating appliances employed is the alignment wire, which has been called the expansion arch. For some time this type of appliance consisted of a threaded arch, as shown in Fig. 225, which was employed for expanding the arch—hence the name expansion arch. It was found in the treatment of malocclusions that it was sometimes necessary to contract the dental arch, and with the advent of intermaxillary anchorage that it was desirable to move the teeth forward and backward with the expansion arch, so Lischer suggested that the appliance be called "alignment wire," as it was more descriptive and less confusing. For instance, we might contract the dental arch with the expansion arch, which is a statement that appears rather contradictory; however, if we say that we contracted the dental arch with the alignment wire, the statement is not confusing.

Alignment wires may be classified into the labial and the lingual alignment wires or arches. Of the labial alignment wires we have the threaded arches that are made in one, two, or three pieces. The one-piece alignment wire, or arch, is the most used. The three-piece arch was recommended for use with the pin attachment for bodily tooth movement. We also have the plain labial alignment wires, one type

of which has been called the loop appliance, because the appliance possesses a number of loops for the purpose of increasing the efficiency of the expansive or contractive force.

Lingual alignment wires, or arches, are placed on the lingual side of the teeth and can be divided into the fixed and the removable. The fixed lingual alignment wire is soldered directly to the molar bands, and the force for moving the teeth is obtained by pinching and bending the alignment wire. The removable lingual alignment wires are attached to the anchor bands by some form of a locking device that will permit the removal of the alignment wire from the anchor bands. Lingual alignment wires are generally used without any threads, although threaded lingual arches have been employed by some. The use of the thread greatly increases the bulk of the appliance, and the

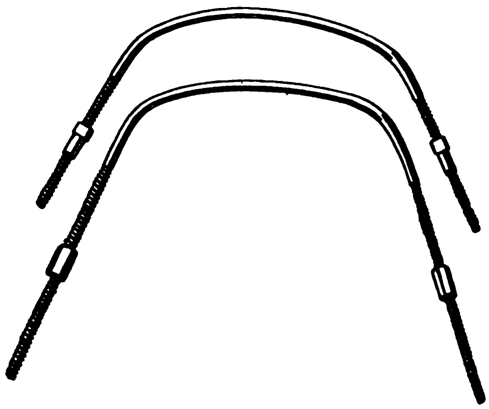

Fig. 225.—Expansion arch with different forms of nuts.

making of the appliance more bulky defeats one of the good qualities of the lingual alignment wire, which is lack of bulk.

The labial alignment wire or expansion arch (Fig. 225) has been evolved from different forms of appliances until at the present time it embodies several principles in a single appliance. It is possible to do anything with the labial alignment wire that can be done with any other appliance, and to do it easier and quicker and with less pain than is possible with some others. It is possible to move a tooth in any direction except that of depressing it in the socket, which movement is even maintained by some. The expansion arch, or alignment wire, can be used with any of the three forms of anchorage. Crude forms of the alignment wire were used by practitioners for a number of years, but it was not employed as a universal appliance until the writings of Angle were given to the profession. The present form of the align-

ment wire can be traced to the plain arch of Angle, which was a part of his device for the treatment of prominent upper anterior teeth. Case employed forms of the alignment wire in the construction of his contouring appliance. Ainsworth likewise used another form of the arch in his appliance, which has been known as the "Ainsworth appliance." The Ainsworth appliance, as originally made, was limited to the expansion of the teeth and not adopted to the various tooth movements as was the Angle arch. As stated before, the plain arch that was used in the retraction of the upper anterior teeth, may be said to be the forerunner of the modern alignment wire. In the plain arch, we have a long spring, which is an ideal appliance for exerting force upon the lateral halves of the arches by means of reciprocal anchorage. With occipital anchorage, it was possible to accomplish good results in a certain number of cases, namely, distoclusion with protruding incisors, or Class II, Division 1. However, these results were not ideal, and in the treatment of neutroclusion, or Class I cases, with its various types, and distoclusion with retruding anterior teeth, or Class II, Division 2, and mesioclusion, or Class III, cases, various combinations of appliances were used and the results were not always ideal. By threading the ends of the plain round arch and putting on the nut, we have an appliance that combines the force of the spring lever and the jackscrew. Then with the improvement of intermaxillary anchorage, it became possible to accomplish better results than had ever been accomplished before. With the proper adjustment of the arch and the addition of a few devices for the movement of the roots of the teeth, the results that can be accomplished are only limited by the ability of the operator.

The expansion arch, or alignment wire, as designed by Angle, possesses a patented nut with a friction sleeve, as shown in Fig. 225, which slips in the end of the tube on the molar band. The round end of the nut fitting in the tube prevents the cheeks from working the nut loose. In order to be of any benefit the round end of the nut must fit the tube closely. Another feature of some of the Angle arches is the making of a small rib into which notches can be filed (Fig. 226), which prevents the ligatures from slipping on the arch. Owing to the fact that the rib on the arch interferes with the even spring of the wire and in a great many cases greatly irritates the lips, the ribbed arch is not used in the author's practice. The ribbed arch was designed to allow the placing of a notch in the rib for the purpose of engaging the ligature so that it would not slip. The rib greatly interfered with the spring of the arch, and the Lourie spur forming plier was designed

for the purpose of making a spur on the arch without taking the arch out of the mouth. This form of pliers has strong beaks, which grasp the alignment wire firmly, while a short lever that moves a sharp chisel is pushed down on the alignment wire, cutting a small delicate spur in the wire without injuring the alignment wire.

Other arches are made by different manufacturers and various forms of nuts have been designed in such a manner that the cheeks will not work them loose. Lock nuts are placed on the arch; others are made with specially designed nuts to prevent them from working loose. Some nuts are made six and eight sided in order that the angles will not be so sharp against the cheek. Various other details to accomplish certain results have been added by orthodontists in the past, but they have always produced complications that, in the author's opinion, have often defeated the end sought. Alignment wires, or expansion arches, are made from various materials. Nickel silver has been more

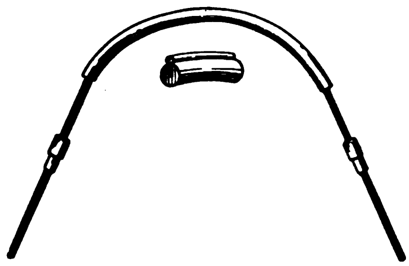

Fig. 226.—Angle's ribbed expansion arch.

widely used in the making of arches than any other material. It is capable of being tempered so as to give the necessary spring. Attachments to nickel silver arches must be made with soft solder, for the use of silver or gold solder will destroy the temper. As it is antiseptic nickel silver saves a great many teeth from decay, which would occur if gold or some other noble metal were used. The objection has been made that they discolor. The author much prefers an appliance that demands care in order to keep it clean than one that invites decay. Gold and platinum came into great favor a few years ago, recommended by its color and by the fact that it possessed more spring than nickel silver and could be used in a smaller gauge. Also, attachments can be made to it with hard solder without destroying the temper. In a great many mouths it discolors more than nickel silver, and the great disadvantage is the absence of any antiseptic property. Iridio-platinum is also used and has the same advantages and disadvantages that gold and platinum has. One of the recent metals or al-

loys to be used is aluminum-bronze, which the author believes more nearly approaches the ideal. It has all of the advantages of nickel silver and many of the advantages of gold and platinum, except that it cannot be soldered with hard solder without destroying the temper. The color is better in a higher percentage of mouths than any other metal. It can be made very tough and springy, and arches of small gauge can be used.

Iridio-platinum, because of its stiffness, makes a very desirable material for the construction of the fixed lingual arch. It is also tough and works nicely with the wire-stretching pliers, which are necessary for the use of the fixed lingual alignment wire. An alloy of iridio-

Fig. 227.—The Lourie spur pliers.

platinum containing about 16 per cent of iridium is best for use with the wire-stretching pliers. Nineteen-gauge is generally employed.

Gold and platinum, elastic gold, and high-fusing clasp metal are employed in the construction of the removable lingual arch because they are slightly more elastic than is iridio-platinum. These are also generally used in 19 gauge.

Sixteen-gauge is employed more in the threaded labial arches. Arches of 18 gauge are often used on the deciduous teeth and in neutroclusion, or Class I, cases where only intramaxillary anchorage is used. If a smaller gauge than 18 of any metal is used there is great

danger that the small diameter of the arch cuts into the cheek. Arches of very small gauge have been introduced by Angle under the name of "The New Angle Appliances," and the ribbon arch. Small gauge arches are also used by Robinson in the Robinson appliance. These have some advantages and some disadvantages. However, they have been used successfully. The 16-gauge arch will long be the standard size, for it can be universally used. It possesses the required spring and strength, without taking up too much room.

Attachments for the Alignment Wire or Expansion Arch.—It will often be found necessary to make three attachments to the expansion arch for various purposes: first, a spur to prevent the ligature from slipping on the arch and to control the direction in which the force is exerted; second, an intermaxillary hook for use in intermaxillary anchorage, and third, a spring extension, or spur, for the movement of the teeth.

Spurs to prevent the ligatures from slipping on arches made of nickel silver or aluminum-bronze must be attached with soft solder. On the gold and platinum and iridio-platinum arches these spurs can be attached with gold solder. The spurs can be made out of ligature wire, a tube or a wire heavier than ligature wire. There is little need that the spur be higher than the diameter of the ligature that it is to hold on the arch. The simple spur (Fig. 228-*A*) is made by flowing a little solder on the end of the ligature wire and then soldering to the arch. Soft solder requires the use of a soft solder flux. A saturated solution of zinc chloride makes the best that the author has tried. This simple spur is of little practical value, for if much force is to be exerted on the ligature it will tear off. The half-loop spur (Fig. 228-*D*) is made by bending a piece of the ligature wire so that it will half encircle the arch. Soft solder is flowed in the bend, the wire is held in the proper position on the arch, heat is applied, and the wire soldered to the arch. The ends of the wire are cut off leaving the spur. If this spur is soldered to the noble metal arch with hard solder, it will be strong enough, provided that the spur has been so placed that the ligature pulls from the entire length of the spur and not against one end. In those cases where it is necessary to open space for an impacted tooth, e. g., a second premolar, a strong spur is necessary. This is best made by wrapping a wire twice around the arch (Fig. 228-*B*) at the proper place and flowing solder entirely around the arch (Fig. 228-*C*). The ends are then trimmed and filed close, which makes a spur that is neat and capable of withstanding all the force necessary. This spur can be made as neat and strong as a tube, and much quicker. In using a tube for a spur,

a piece of tubing is selected with an inside gauge the same as the gauge of the arch. A piece is cut from the tube of sufficient length to afford solder attachment that will be strong enough to withstand the force, the nut removed from the arch and the tube slipped to the desired posi-

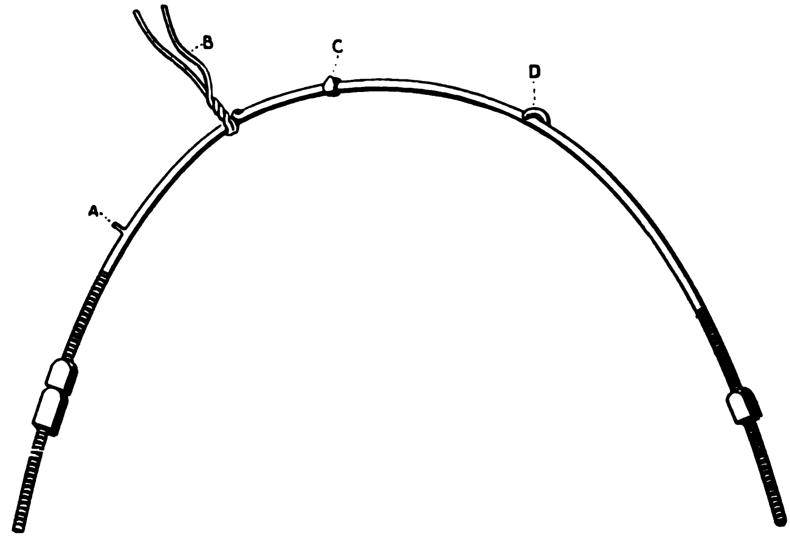

Fig. 228.—Forms of soft-solder spurs. *A*, simple spur; *B*, wire-twisted before flowing soft-solder; *C*, spur made by flowing soft-solder over *B*; *D*, half-loop spur.

tion on the arch, which has previously had flux placed on it. A small piece of solder is laid on the arch at one end of the tube. The other end of the tube is then heated and the solder "pulled" through the tube. Split tubes that can be placed on the arch without removing the nut are obtainable, but they are not so strong.

The second attachment to be placed on the expansion arch is the

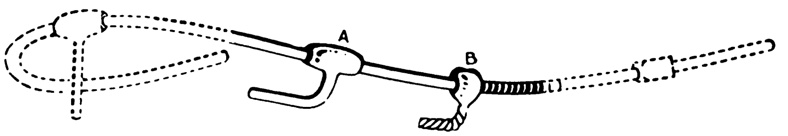

Fig. 229.—A, sheath- or intermaxillary-hook made by soldering wire to tube and soft-soldering tube to arch. *B*, Intermaxillary-hook made twisting ligature wire around arch to which it is then fastened with soft-solder.

sheath-, intermaxillary-, or tube-hook. These different terms are synonymous, and the hooks consist of some form of attachment for the rubber ligatures when intermaxillary anchorage is used. Sometimes hooks are placed on the arches to engage a rubber ligature not used with inter-

maxillary anchorage, in which case the term intermaxillary-hook would be wrong. The standard form of sheath-hook consists of a piece of wire soldered to a small tube and bent in the form of a hook, as shown in Fig. 229-A. The tube is slipped over the arch and attached in the same manner that a tube is soldered to the arch, as described on page 193. Various forms of hooks have been made, but one that is simple serves the purpose as well as one of peculiar pattern. Hooks can be made by wrapping a wire around the arch and bending the ends in a hook, then soldering it so as to attach the wire to the arch, and strengthening the wire in the hook portion (Fig. 229-*B*). This hook is neat and strong and can be made without taking the nut off the arch. Very often the hooks can be placed on the arch so as to serve the purpose of the spur also. When gold and platinum or iridio-platinum arches are used, a piece of wire of suitable gauge can be soldered to the arch direct, with hard solder, and then bent into a hook.

The third form of attachment to the arch is *spurs for the bodily move-*

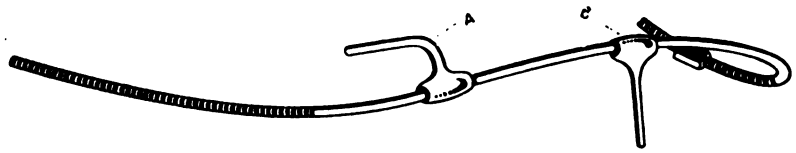

Fig. 230.—*A*, spur used to depress prominent canines; *B*, spur used in bodily movement of teeth.

ment of the teeth, or spurs to move the apex more than the crown, or to depress teeth.

As these spurs must withstand considerable force, it is necessary that they be firmly attached to the arch. With gold and platinum and iridio-platinum arches the spur can be soldered directly to the arch. The spur should be so placed that it will occupy a central axis of the tooth mesio-distally. The tooth is attached to the arch and held in such a manner that it will occupy a perpendicular relation to the spur. If the apex is to move more than the crown, the spur is so bent as to exert that manner of force. When nickel silver or aluminum-bronze is used, hard solder cannot be employed or the temper of the arch will be destroyed. In that case the wire is soldered to a tube (Fig. 230-A) that is the right size to slip over the arch. The tube is placed at the proper position on the arch and pinched slightly with a wire cutter. The pinching of the tube with a wire cutter makes the tube fit tightly to the arch so that it will not turn and slip while the arch is being removed from the mouth and placed over the flame to be soldered. The tube-spur is

soldered by placing flux and solder at one end of the tube and gently heating the other end to pull the solder through the tube (Fig. 230-*B*).

Application of the Labial Alignment Wire or Expansion Arch.—As the labial expansion arch, with the bands and ligatures that go with it, is the most widely used of all appliances, it becomes necessary that the principles of applying the arch be fully understood. In the hands of the skilled, or in the hands of those who properly adjust it, it becomes a valuable appliance—so valuable that it is the only form of appliance that is needed, with the occasional use of the traction screw.

It must be remembered that the arch embodies two forms of mechanical devices— the screw and the spring lever; therefore we have an enormous amount of mechanical force at our disposal.

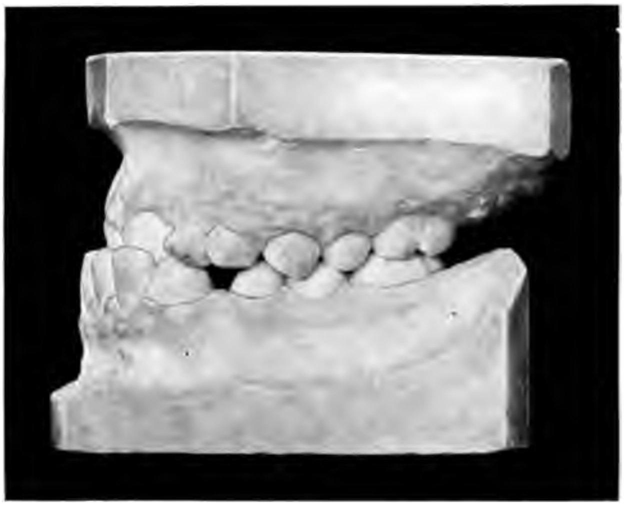

Fig. 231.—Case in which anterior teeth only need moving.

In using the expansion arch, or alignment wire, one must be familiar with the various forms of anchorage in order to obtain the best results. In applying the alignment wire, or expansion arch, to move the anterior teeth forward, we depend upon simple anchorage obtained from the molar teeth that have been fitted with bands. The tubes on the molar band must be so placed and the sides of the arch aligned so that the tube and arch will be parallel to each other before the arch is placed in the tube. If this is not done, the molars will be rotated by the spring of the arch if the arch is not parallel to the tube. In moving the anterior teeth forward, if that is the only movement that is to be made, as seen in Fig. 231, the sides of the arch are only as wide as the tubes on

the molar band (Fig. 232). It is unnecessary to spring the arch to get it in the tubes. The side of the arch lies close to the teeth so as to avoid any irritation to the cheeks. The anterior portion of the arch stands slightly away from the teeth. In applying the arch to this class of cases, one side of the arch is placed in the tube on the molar band and the position noted. If the arch is too long, the nut is turned forward until the arch is the proper size, and if the end projects through the tube, the end of the arch is cut off so that it will be covered by the tube and not irritate the cheek. The arch is again placed in the tube on the same side only, and if the tube on the band is properly placed, the side of the arch will lie close to the teeth. The position of the canine is noted, a small scratch is made opposite it and the arch is removed. A

Fig. 232.—Showing relation of screws on band close to premolars and expansion arch without any expansion.

bend is made in the arch opposite the canine in order that the anterior part will lay close to the anterior teeth. This bend should be made so that it will cause the anterior part of the arch to occupy the proper position to the six anterior teeth. It may be necessary to try the arch several times before the anterior part occupies the place intended. With the same end of the arch in the same tube and holding the arch in the proper position to the anterior teeth, the position of the opposite canine is noted and marked on the arch. The arch is removed, and the bend made in the canine region where marked so that the side of the arch occupies the proper relation to the tube. The side of the arch that was first fitted on the teeth is again placed into the tube and all positions of

the arch noted. The side that was bent last should not be put into the tube until the nut has been placed at the proper position, the end cut off at the proper length, and the side so bent that the end of the arch

Fig. 233.—Position of arch to expand molar without rotating same.

Fig. 234.—Left side shows relation of tube and arch to rotate mesio-buccal angle of molar.

lies parallel to the tube, when the anterior portion of the arch is held in position with the fingers. This shows that there is no spring in the arch that will be exerted upon the molars. After it appears that the

arch is properly aligned, insert the side that was fitted last into the tube, leaving the other side out, and notice what position the arch occupies to the tube when free. It should lie parallel and in exact relation to the tube, which shows there is no spring on that side. Now both sides

Fig. 235.—Arch adjusted to rotate distal angle of molar buccally.

Fig. 236.—Position of arch to rotate mesio-buccal angle of molar lingually.

of the arch can be placed in the tube and it should go into place without binding.

If the arch is to be applied to a case that requires expansion in the olar region, the same procedure is followed in the fitting of the arch,

except that the arch is left wider in the canine region and the sides of the arch are so bent that they are parallel to the tubes but stand buccal to the tubes before the ends are inserted into them. Fig. 233 shows how the ends of the arch must be parallel to the tubes. If the arch and tube are not parallel the molar will be rotated by the spring of the arch. Very often this is taken advantage of when the molars are in torsi-occlusion, or torsiversion. If the arch and tube occupy the relation shown in Fig. 234, the mesio-buccal angle of the molar would be moved buccally. If they occupy the relation shown in Fig. 235, the disto-buccal angle would be turned buccally. If they occupy the relation shown in

Fig. 237.—Position of arch and tube to rotate mesial angle of molar lingually and distal angle buccally.

Fig. 236, before the arch is placed in the tube, the mesial portion of the tooth would be rotated lingually. If the tube and arch occupy the relation shown to each other in Fig. 237, when the arch is placed in the tube, the molar would be rotated in the center. Other forms of application will be shown in the treatment of cases.

Loop Labial Alignment Wires

The labial wire is used also without threaded ends for various tooth movements and has become known as the loop appliance. Loops have long been used in conjunction with other forms of forces. They were employed by Ainsworth many years ago in what has been known as the Ainsworth appliance. This appliance consisted in the use of labial arches that were attached to the anchor bands by vertical tubes for the

purpose of expanding the arches. They were also held in place by various forms of locking devices. In some cases, loops were made in the labial arches, and in others, the ends of the labial arches were only bent at right angles and placed in the perpendicular tubes on the anchor bands. The use of loops was also early employed by Barnes and Pullen.

Fig 238.

Fig. 239.

Figs. 238 and 239.—Loop appliance and case on which it was used.

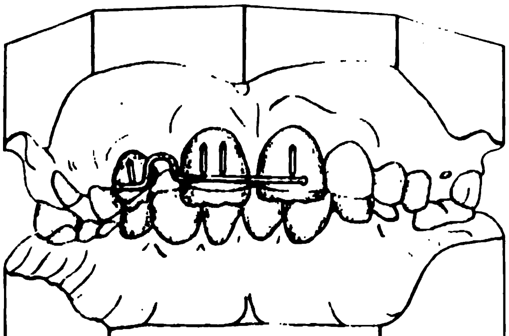

Fig. 240.—Loop used in conjunction with pins and tubes. (Pullen.)

Loops have been used much more extensively within the last few years, and are used with appliances that are designed to move teeth bodily, and also with the plain wire ligatures. The advantage of the loop appliance is the ease with which it can be constructed, owing to the fact that

no threads or nuts are required. In the absence of threads and nuts, the tissues also take more kindly to the appliance. The loop also gives a greater range of elasticity, and can be made to accomplish practically everything that can be done with the screw; however, it must be remembered that the spring force of the loop is not so positive as the screw force but that it acts over a greater range. The loop can be used in the treatment of simple cases or of those that are more complicated. Fig. 238 shows a simple case of malocclusion, which was treated by the use of the loop appliance shown in Fig. 239. Plain bands were placed on the molars for anchorage, and perpendicular tubes were soldered on the buccal surface of the molar bands, as can be seen by studying the appliance shown in Fig. 239. The end of the labial wire was bent gingivally to form a lock similar to the lock that has been described by

Fig. 241.

Fig. 242.

Figs. 241 and 242.—The application of the loop alignment wire in neutroclusion.

Young, and used by others. A loop was made in the labial wire about the region of the first deciduous molar for the purpose of exerting the force necessary to move the incisor forward, which was in lingual occlusion.

Another use of the loop in a simple appliance is shown in Fig. 240, which was used not as an expanding force but as a contractile force for the purpose of moving the lateral toward the centrals.

The loop appliance can be used in more complicated cases and is extremely valuable in cases requiring expansion, as shown in Figs. 241 and 242. The front view shows a loop in the lower wire in the region of the central incisors, which is for the purpose of exerting an expansive force in the anterior part of the dental arch. By opening the loop, the canine

portions of the wire will be carried labially or rather buccally. In opening a loop of this character, it must be opened on both sides so that the labial wire may be kept straight. Owing to the fact that more expansion is required in the upper dental arch than in the lower, a loop is made in the upper alignment wire in the region of the upper canines. By turning this loop gingivally and by having it press against the canines, it can be made to exert a downward pressure on the prominent canines if desired. By opening the superior canine loops the wire is

Fig. 243.—Occlusal view of loop alignment wire.

Fig. 244.—Loop alignment wire used in combination with threaded section of arch on lower teeth for making space to accommodate the premolar.

increased in size and room is made for the placement of the teeth. In Fig. 242 it will be seen that the lower wire has a loop turned gingivally, which is directly in front of the parallel tube on the molar band. This loop serves the double purpose of preventing the labial wire from slipping distally through the tube and also of providing a means of increasing the length of the lateral halves of the labial arch. Care must be observed with these labial loops that are turned gingivally that they are so bent that they do not impinge upon the gum tissue. The upper

labial loop alignment wire is attached to the anchor tube by means of a perpendicular tube soldered on the band. The distal end of the wire is bent to form a lock. As the labial wire rests at the occlusal part of the band, the appliance must be bent gingivally to give the wire a posi-

Fig. 245.

Fig. 246.

Figs. 245 and 246.—Loop alignment wire showing use of spur on maxillary lateral and combination of loop appliance with threaded arch.

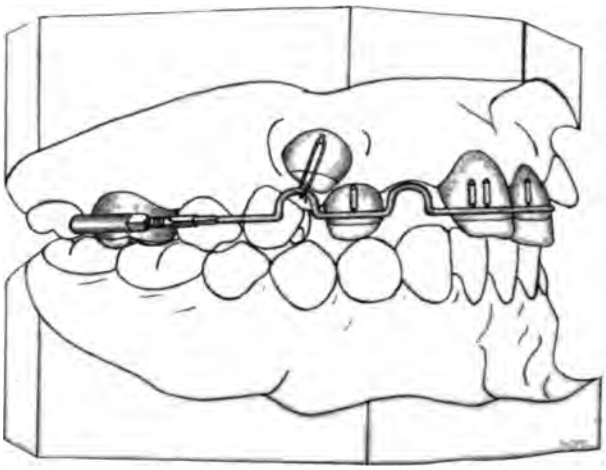

Fig. 247.—Loop used in conjunction with threaded arch and pins and tubes. (Pullen.)

tion suitable for the attachment of wire ligatures. It will also be observed that a loop is made in the labial wire at the region of the premolars, which serves the purpose of a spur to prevent the tipping of

the premolars that are ligated tight to the perpendiclar part of the loop. The occlusal view of the appliance is shown in Fig. 243.

The loop appliance can be used in various combinations, and different attachments can be made for various tooth movements. Fig. 244 shows the application of the loop appliance to a case that presents several complications of adjustment. The occlusal view of the lower model shows that the lower left premolar is impacted and deflected to the lingual. The lower appliance is a combination of the screw labial wire and the loop labial wire. The screw is used on the left side for the purpose of moving the anterior teeth forward to make room for the impacted tooth. On the right side the loop is attached to the molar band by means of a perpendicular spur in a perpendicular tube. This attachment permits a bucco-lingual hinge between the band and appliance, and avoids a tendency of the right molar to be rotated as the anterior teeth are carried forward and over by the screw on the left side. The occlusal view of the upper model shows to what extent the upper right canine is in lingual occlusion and the apical movement that is necessary for the upper lateral incisor. Figs. 245 and 246 show the adjustments of the appliances with the expansion spur on the upper labial arch to control the apical movement of the lateral incisor.

The loop is used also in other combinations and with other forms of the screw, one type of which is shown in Fig. 247, after Pullen. Further descriptions of the various combinations will be found under the head of bodily tooth movements.

Lingual Arches, or Alignment Wires

Lingual arches, or alignment wires, are distinguished from labial arches by the fact that they are placed on the inside of the dental arch or on the lingual side of the teeth. Who was the first to make use of the lingual arch as a regulating appliance is not known to the author. Crude forms of lingual appliances have been offered by certain manufacturers for some time. The Jackson crib appliance, or the Jackson removable appliance, is a lingual appliance that possesses many virtues and is described in another chapter. Lingual arches or wires were also used for some years as retaining appliances, but the use of the lingual arch as a regulating appliance, as described in this chapter, belongs to Lourie and Mershon, the technique of each being slightly different.

The use of the lingual arch as described by Lourie was evolved from the lingual wire as used in retention by various practitioners for a number of years, and was brought to a highly efficient point because of

the many valuable features that it possesses. The ease with which the appliance moves teeth, the inconspicuousness of the appliance, along with the mechanical principles involved also influenced Mershon in perfecting his technique.

Lingual arches may be divided into the fixed and the removable, or those that are soldered to the anchor bands and those that have some form of attachment to the anchor bands that permits of their removal. Both types are not to be removed by the patient, and in that sense are fixed. The lingual arch that is soldered is the type that has been evolved by Lourie, and the one with removable attachments to the anchor bands has been used by Mershon.

Lingual wires or arches may also be used with one end soldered to one molar band and the other end may have an attachment in a tube. Lingual arches made with the one side soldered to the band and one side

Fig. 248.—Lingual arch soldered to molar bands. (Lourie.)

attached into a parallel tube on the opposite molar band offer many advantages in relation to anchorage and tooth movement in certain forms of malocclusions.

The lingual arch soldered to the anchor bands was developed from the retaining wire and was utilized by the employment of the principle of stretching wire with the wire stretchers, as first practiced by Angle. Lingual arches that are soldered to molar bands may be used in three ways or for four purposes. *First,* they may be used as a retaining appliance which was the first and original use of the soldered lingual arch. In this form the lingual wire is passive. The *second* use was evolved from this passive form by making the appliance active or to exert force on the teeth by means of the wire-stretching pliers. The *third* use of the lingual arch or wire is when the appliance is used as a form against which the malposed teeth are molded, either by means of ligature or

by means of pressure exerted on the malposed teeth from the use of the high labial arch and finger springs. The *fourth* use of the wire soldered to the lingual bands is to use the lingual arch as a means of stabilizing the anchor teeth. This last use is very important and especially when the force on the malposed teeth is derived from a small gauge spring wire or finger spring.

The soldered lingual arch is best used by having plain bands on the anchor teeth, which are selected according to the requirements of the case. Fig. 248 shows the plain bands upon the second deciduous molars

Fig. 249.—Angle wire-stretching pliers.

Fig. 250.—Lourie wire-stretching pliers.

to which the lingual wire is soldered. The technique of making this appliance consists in making the plain bands, placing them on the teeth, and taking a good modeling compound impression. The bands are placed in the impression, and a model is made that has the bands in position on the anchor teeth. The lingual wire is then fitted to the model and soldered in place to the bands. The lingual arch is shaped to give the desired tooth movement. In Fig. 248 expansion was required in the canine region, and the arch is placed against the lateral halves of the

dental arch and the required force is exerted by use of the wire stretchers.

The wire stretchers, as designed by Angle, are shown in Fig. 249, and are a heavy pair of pliers with short round beaks for the purpose of pinching the wire and thereby increasing its length. A pair of pliers for the same purpose, but much smaller, as designed by Lourie, is shown in Fig. 250.

In considering the lingual arch it is well to think of it as being composed of the incisal section, which is that part extending from one canine to the other, and the premolar and molar sections, which are the right and left parts that are distal to the canines. By pinching the wire in

Fig. 251.—Bogue pliers.

Fig. 252.—Modified How pliers.

the incisal section, as shown adjusted in Fig. 248, the canines will be expanded and the premolar or molar section will be carried buccally. The expansion of the molars can be increased by bending the wire buccally distal to the canine bends, by means of the Bogue pliers as shown in Fig. 251. When bending the premolar section of the lingual arch buccally in the premolar region, there will be a rotation of the distal corner of the molar buccally unless another slight bend or offset is made lingually to counteract that tendency. The occlusal relation of the soldered lingual arch can also be changed by the use of the modified How pliers, shown in Fig. 252.

The lingual arch can also be bent with the stretching pliers at the

time the pinch is being made. This makes what may be termed a "dead" bend, as pinching the wire at the time it is bent prevents the occurrence of any backward spring, as is often the case when bends are made with the pliers as shown in Figs. 251 and 252.

Technique of Wire Stretching.—In considering the use of the soldered lingual arch or wire it is well to remember some of the basic principles employed in the use of such an appliance. We have already mentioned the styles of wire-stretching pliers but there is a mechanical principle in the construction and use of these pliers that must be remembered. The beaks of the pliers must be cylinders of the same circumference, that are parallel at the finish of the pinch. Any deviation from that style, shape or relation of the beaks will distort the wire and produce a change in the shape of the appliance which will be undesirable and produce pressure on the malposed tooth or anchor tooth in such a manner as to defeat the purpose of the appliance. It must further be remembered that a pair of wire-stretching pliers which have the beaks shaped and set to pinch one gauge of wire must only be used on that gauge. For example, if beaks of the pliers are shaped and set to pinch a 19-gauge wire and they are used on an 18-gauge wire, it will be found that instead of the wire being lengthened in a straight line or without curvature, the ends of the wire will bend away from the pliers. If wire-stretching pliers designed to pinch 19-gauge wire are used on a 20-gauge wire, the ends of the wire will be bent toward the plier handle.

Fig. 253 shows the relation the beaks of the pliers must bear to each other at the close of the pinch. If the beaks are parallel cylinders (or cylinders of the same diameter which are parallel to each other) at the close of the pinch, the wire will be lengthened without any curvature. If the external portion of the beaks of the pliers close more nearly together than the internal portion, the ends of the wire will be turned toward the handle as shown in Fig. 254. In Fig. 254, *A* represents a piece of straight wire before the beginning of the pinch with pliers the beaks of which resemble the general outline shown in Fig. 254. At the completion of the pinch, the straight piece of wire shown at *A* will assume the position represented by *B*. It can readily be seen what a large amount of harm would be done to a regulating appliance if a wire was pinched with this style of pliers without the operator realizing what was taking place.

If, on the other hand, pliers are used of which the external portion of the beak does not close as tightly as the internal portion, the wire would be turned away from the pliers as illustrated in Fig. 255.

A of Fig. 255 represents the straight piece of wire before the begin-

ning of the pinch, while *B* shows the manner in which the wire would be curved if pinched by a pliers, the beaks of which had a general relation as shown in Fig. 255. It must be remembered that the relation of the beaks of the pliers as illustrated in Figs. 254 and 255 are exaggerated, and, of course, can readily be detected by the eye. In actual practice, it must be remembered, that such a small variation as cannot be detected by the eye, will produce changes in the wire as illustrated in Figs. 254 and 255. It therefore becomes necessary before using a wire-stretching pliers to take a straight piece of wire and pinch it outside of the mouth and carefully observe what results have taken place.

There is probably no force used in the correction of irregularities that has as many advantages as the force obtained from the wire-stretching pliers properly applied. It can equally be said that there is no force which is liable to do more harm than that obtained from the wire-stretching pliers, if their use is not understood or if the beaks of the pliers are

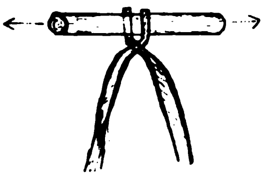

Fig. 253.

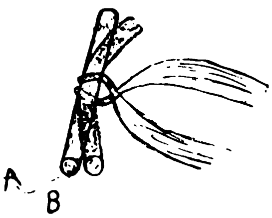

Fig. 254.

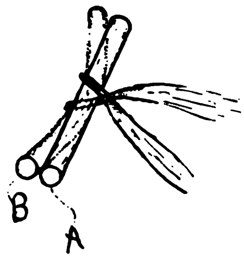

Fig. 255.

improperly shaped, because of the fact the force is exerted so gradually that the tooth change occurs without the operator realizing how these changes are occurring. We are aware of the fact that a great many men have begun using the wire-stretching pliers before they have become familiar with their mechanical action, and consequently have produced many undesirable tooth movements without being aware of how those movements occurred. The author would caution all to first be absolutely certain that the beaks of the wire-stretching pliers are so shaped as to produce a straight pinch, or rather a pinch which will lengthen the wire without bending it. Second, it must be remembered that the wire-stretching pliers adjusted to one gauge of wire cannot be used on another gauge of wire. Third, it must be remembered that the wire used with the wire-stretching pliers must be one which is capable of giving an even pinch without the wire becoming brittle during the pinching.

It has been found that some of the alloys containing gold and platinum are unsuited for use with the wire-stretching pliers because these metals seem to crystallize during the pinch, which results in the wire breaking at the place where the pinch is made. Other alloys are entirely too hard which have resulted in the breaking of the wire-stretching pliers as well as in producing a pinch that is brittle. At the present time the most satisfactory wire for use with the wire-stretching pliers is a 16 per cent iridio-platinum wire. It must also be remembered that in making a pinch on a lingual or labial arch with the wire-stretching pliers a certain tooth movement will be produced according to the place and manner in which the pinch is made.

The following diagrams have been made to show the mechanics of the wire-stretching pliers, and the changes that occur as a result of the pinch and various manipulations of the pliers during the pinch. The force resulting from the use of the pliers is accurately shown in the

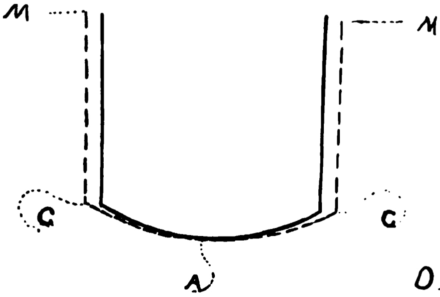

Fig. 256.

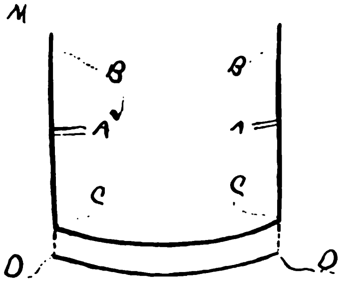

Fig. 257.

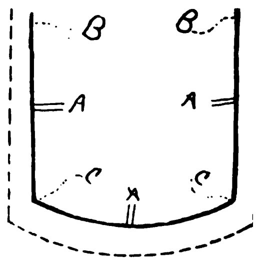

Fig. 258.

diagrams, and can be proved by technical demonstration, provided both ends of the wire are held rigid during the pinch. In the use of the wire-stretching pliers on an appliance, it must be remembered that the resulting movements of the teeth will depend upon the anchorage and resistance offered by the supporting structures.

The solid line drawing in Fig. 256 represents a lingual wire which is soldered to the molar band. If it is desired to produce a buccal expansion of the molar and premolar region, a pinch made in the lingual wire somewhere in the incisal portion about the region of *A* will produce a lengthening of the lingual wire from *C* to *C* which in turn will carry the lateral halves of the wire from *C* to *M* buccally. This pinch made in the incisal portion of the arch preferably near the central part will lengthen the wire from *C* to *C* and produce the expansion as shown by the dash line in Fig. 256. If pinches are made in the canine portion

of the wire, a pinch must be made on both the right and left side to produce an equal expansion. If a pinch is made only on one side of the wire in the canine region, it will produce a change in the wire as shown in Fig. 262. In order to produce an equal expansion in both the canine and molar regions, the pinch in the incisal portion at *A* must be made with the beaks of the pliers held absolutely stationary, without a movement forward or backward or without any rotation of the handle of the pliers. It is never advisable to make more than two pinches at one sitting in the incisal portion of the arch. Care must be taken not to place enough stress upon the wire between *C* and *C* as to produce a bend in the wire. It must remain absolutely the same except in length in order to produce an expansion in the molar region without rotating or tipping the molars. If a sufficient number of pinches are made at one sitting to strain the wire and produce a bend from *C* to *C*, the molars will be tipped or rotated in some manner.

In Fig. 256 it has been shown that if the wire-stretching pliers are placed in the incisal portion of the alignment wire between *C* and *C* and a pinch is made without moving the beaks the alignment wire will be widened in such a manner as illustrated by the dotted line.

If the alignment wire is pinched anywhere in the molar region between *B* and *C* as illustrated in Fig. 257 the premolar section of the alignment wire will be lengthened between *B* and *C* and the incisal section will be carried forward to the position represented by *D;* that is, the incisal section will be carried forward provided the molars are not moved distally. The purpose of Fig. 257 is to illustrate the possibility of lengthening the premolar section of the lateral halves of the dental arch by pinching the alignment wire in the premolar region and carrying the incisors forward without any expansion in the incisal portion.

If it is desired to expand in the molar and premolar region, and at the same time carry the incisal portion of the alignment wire forward, thereby expanding the dental arch in all regions, that tooth movement can be produced by making pinches in both the incisal and the premolar sections at points illustrated by *A* in Fig. 258. In order to produce this increase in size of the alignment wire and thereby expand the dental arch as illustrated by the dotted line in Fig. 258, the wire-stretching pliers placed at point *A* must be held stationary and not rotated or the handles moved during the time the pinch is being made. By making a pinch anywhere between *B* and *C* the lateral half of the alignment wire will be lengthened, by making a similar pinch between *C* and *C*

the dental arch will be expanded or the alignment wire will be lengthened in the incisal portion.

Realizing the fact that any change in shape of the lingual wire from *C* to *C* will produce a certain degree of movement in the molar region, we will find in certain cases it is desirable to move the molars or expand the molars more than the canines. As a result of this, it is therefore necessary that we be familiar with the peculiarities of the action of wire under the wire-stretching pliers in order to produce the movement desired in the molar region. In Fig. 259 the heavy black line represents the lingual wire soldered to the molar bands. In this particular case it is desired to produce more of an expansion in the molar region than in the canine region, and also to produce an equal expansion of the molars on the right and the left side. This can be accomplished by placing the wire-stretching pliers at a point on the lingual wire represented

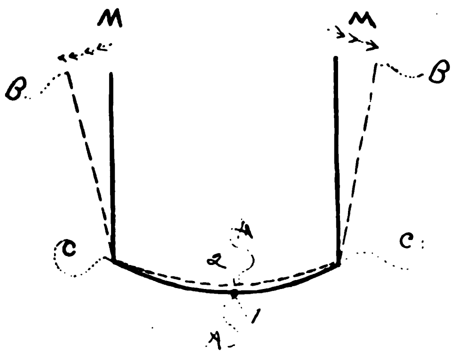

Fig. 259.

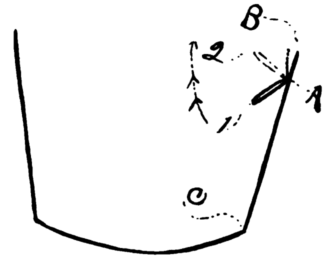

Fig. 260.

by 1*A* and while the pinch is being made, traction is made upon the wire-stretching pliers towards the molars so as to change the position of the pliers from 1*A* to 2*A*. As a result, the position of the lingual wire will be changed as shown by the dotted line from *C* to *C* resulting in a pressure being placed on the molars represented by the dash line from *B* to *C*. This will throw the right and left molar region buccally in the relation as shown by the dotted line which of course will move the distal portion of the molar more buccally than the mesial portion.

In some instances it is desirable to have this type of expansion of the molars; but instead of having the distal end of the molar moved more buccally than the mesial end, it is desired to move the mesial end equally as far as the distal. This movement of the molar buccally in a straight line is then produced by making a second pinch in the lingual arch in

the region of the molar as shown in Fig. 260. In Fig. 260 the heavy black line represents the lingual wire as shown by the dash line in Fig. 259. It will be noted that the distal end of the heavy left back arch is thrown out the same as the alignment wire is in Fig. 259. Therefore, if it is desired to move the molars buccally without any torsiversion of the distal corner, the wire-stretching pliers is placed on the arch at *A* in the position as shown by drawing 1. As a pinch is made, the handles of the pliers are rotated distally from position *1* to position *2* as shown by the solid and dotted handles. As a result of this movement a bend at point *A* is made in the alignment wire from *A* to *B* which has no elasticity. From *A* to *C* the alignment wire is sprung, and because of this elactic spring from *A* to *C* the lingual wire returns to the original position represented by the black line with the result that the dead bend from *A* to *B* stays in the alignment wire, effecting a change in the position from *A* to *B* as represented by the dotted line. Because of this dead bend in the alignment wire in the molar region the mesial corner of the molar will be rotated and made to occupy the position represented by the small dotted line.

By a careful study of Figs. 259 and 260 it will be seen what a change can be produced in the shape of the alignment wire by making the two pinches illustrated. The first pinch made in the incisal portion of the wire (Fig. 259) at point *A* and by moving the pliers distally at the same time the pinch is being made results in a change shown by the dash line in Fig. 259. After that pinch is made, the second pinch and bend shown in Fig. 260 made near the molar band results in the rotation of the molar. The various changes shown in the molars in these two diagrams must be carefully carried in mind and they also illustrate the necessity of being perfectly familiar with each pinch and bend that the wire-stretching pliers will produce upon the various teeth.

In Fig. 261 we have an illustration that shows the possibility of producing a lingual movement in the molars as a result of the wire-stretching pliers. Again, the heavy black line represents the shape of the alignment wire before any stress is brought to bear upon it by means of wire-stretching pliers. In this illustration, the wire-stretching pliers are placed in position shown by 1*A* which is an incisal portion of the wire somewhere between the canines *C* and as the pinch is made the pliers is forced forward with the result that the incisal section of the alignment wire is changed as represented by the dash line. The distal ends of the alignment wire, which are soldered to the molar bands, will be carried lingually, resulting in a narrowing of the molar region. There are very few cases in which a lingual movement of the molars is desired;

but in those cases where it is desired, it is one of the most satisfactory means of accomplishing the change. The lingual movement of the molars has been accomplished in a great many cases when men have not desired that movement, because they unconsciously have produced movement with the wire-stretching pliers which is illustrated in Fig. 261 in position 1*A* and 2*A* of the pliers.

It must be remembered that pinches made with the wire-stretching pliers at different positions will produce different changes in the shape of the alignment wire and therefore produce different tooth movements. It must also be remembered that a radical different change in the shape of the alignment wire will be produced when the pinch is made in a straight portion of the wire or when it is made in a curved portion. A large majority of the lingual wires have a greater curve in the canine region as is illustrated in the curvature between *B1* and *C1* in

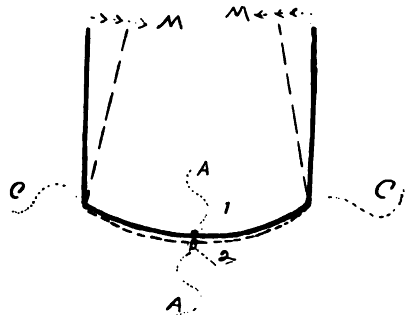
Fig. 261.

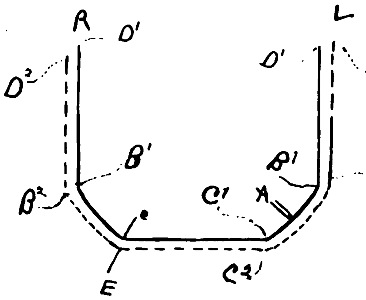
Fig. 262.

Fig. 262. If the wire-stretching pliers represented by *A* pinch the wire in the curved section between *B1* and *C1*, it will result in a two-fold movement which will be a carrying buccally of the premolar section to the dash line as shown between *B2* and *D2*. The portion of the alignment wire *C1* will be carried forward in the position shown at *C2*. This is the result of the lengthening produced by the pinch made at *A* in the curved portion of the alignment wire between *B* and *C*. It will be noticed that the incisal section of the alignment wire as represented by *C* and *E* have not been lengthened; neither has the premolar portion of the alignment wire represented by that portion between *B* and *D*. The only lengthening in the alignment wire has occurred in the curved section between *B* and *C* as a result of the pinch *A*.

Pinching the alignment wire between the points *B* and *C*, will exert a backward force upon the left molar that will tend to force it distally, as illustrated by the dash line as related to the solid line. A forward

force will be exerted on the right molar which will tend to move it forward. This force can be utilized when it is desired to move one side of the arch forward and the other side backward, always remembering that the movements will vary according to the resistance offered by the various teeth.

Several pinches can be made in that section of the alignment wire between *B* and *C* but each pinch, provided the wire-stretching pliers are held stationary and the pinch is made at right angles to the wire, will result in changes as shown by the dash line and the only lengthening will occur in that portion of the wire between *B* and *C*. If a pinch is made only in the curved portion of the alignment wire on one side as illustrated in Fig. 262, it will produce a change in the shape of the alignment wire as shown in the dash line. In other words, it will produce an expansion in the canine region of the dental arch on one side only resulting in what might be termed a warping of the dental arch

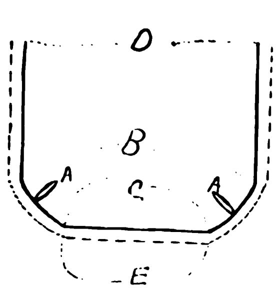

Fig. 263.

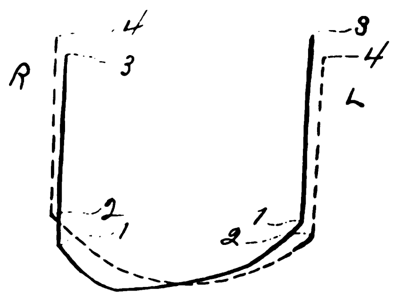

Fig. 264.

which can be seen by studying Fig. 262. In a number of cases this style of tooth movement may be desired, but in other cases the operator may get this movement without knowing how he produces it and it may not be a desired movement. We therefore caution all who begin the use of the wire-stretching pliers to realize that the force produced is constant and every time a wire is pinched a particular and positive effect is produced according to the position in which the pinch is made, the manner in which the beaks are held or moved during that pinch, and the position in which the pliers are placed on the wire. Now this warping of the alignment wire as a result of the pinch in the curved section as shown in Fig. 262 may be desirable, in fact, it can be utilized to cause the alignment wire and dental arch to assume a shape which will result in moving the molar section forward on one side and distal on the other as before mentioned.

Fig. 263 shows the change in shape, which would occur if the alignment wire was pinched an equal amount in the canine region on the right and the left side. Pinches made in the wire between the points *B* and *C* would increase the length of the wire in that section and leave the length from *B* to *D* unchanged. Likewise the incisal portion of the wire *E* would be unchanged.

In Fig. 264 we have a diagram which requires a very careful study in order to realize the peculiar possibilities and movements which can be accomplished by the wire-stretching pliers used under certain conditions. Fig. 264 illustrates the possibilities of changing the shape of the lingual alignment wire by means of the wire-stretching pliers in such a manner as to move one lateral half of the arch forward and the other backward with no other force except the pinched wire. The heavy black diagram represents the shape of the alignment wire before any pinches are made. On the right side of the alignment wire marked *R* the wire-stretching pliers are placed in the canine region at the point on the heavy line shown as *1*. As the pinch is made the pliers is moved distally to the point shown at *2* which results in a change of the curvature of the alignment wire in that region represented by the dotted line. On the left hand side in the canine region, the pliers represented at *1* is placed on the wire and as the pinch is made the pliers is forced forward, causing a change in the curvature of the wire as again represented by the dotted line. This results in the canine portion of the lingual wire on the right side being so curved and shaped as to assume a distal spring, and the one on the left side is made to assume a mesial spring. As a result of this, the right premolar region of the alignment wire shifts distally from the position *3* to *4*. On the left side a mesial shifting occurs in the premolar region from the position *3* to *4*. It will be seen then by this diagram, as a result of the pinches as outlined, that the right half of the alignment wire has shifted backward and the left half has shifted forward. This movement is very desirable in certain cases and also may be produced accidentally if the operator is not familiar with the technique of the pliers.

In some cases we find it is desirable to place upon the canines bands to which a wire has been soldered. Very often with this style of appliance, it is desired to change the perpendicular relation of the canines, which can be very easily accomplished as shown in Fig. 265. The dark, heavy perpendicular line and the cross line represent the position of the canine and the position which the wire occupies before any pinch has been made in it. Now, if the wire-stretching pliers is placed at *A* in the position *1* and as the pinch is made the pliers is moved occlusally,

it will result in a change in the wire which will produce a tipping of the apices toward each other and the moving of the crown buccally. A reverse movement of the canines can be accomplished as shown in Fig. 266 if the wire-stretching pliers *A* is placed at the position *1* and as the pinch is made is moved gingivally to *2* which will change the wire in such a manner as to tip the crown lingually and the apices labially as shown by the dash line. Besides being possible to tip the canines in

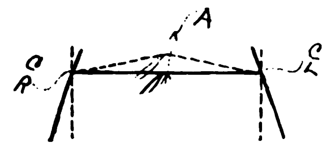

Fig. 265.

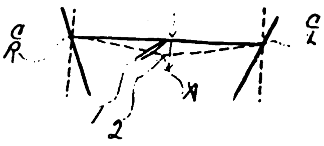

Fig. 266.

either direction as shown by Figs. 265 and 266 the expansion of the canine can also be accomplished by making straight pinches anywhere on the wire between the two canines.

Another valuable force that can be obtained from the use of the wire-stretching pliers is found in the torsional spring of the wire. This force is obtained by pinching and twisting the wire in such a manner as to produce a torsional spring and a dead bend in the wire. The nature of the torsional spring and the movement produced by it can be best

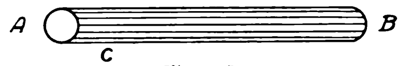

Fig. 267.

Fig. 268.

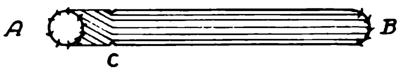

Fig. 269.

understood by studying Fig. 267 which represents a straight piece of wire without any torsional spring. The wire is attached at the ends *A* and *B*. The pliers is placed at the point *C* and as the wire is gripped between the beaks, the pliers is rotated so as to twist the wire as shown in Fig. 268. From the point *A* to *C* in Fig. 268 the wire is twisted beyond the range of elasticity and remains in that shape. From *C* to *B* the wire has a torsional spring and returns to its original shape as shown

in Fig. 269. In Fig. 269 the end of the wire *A* will be rotated by the torsional spring in that portion of the wire from *C* to *B* provided the end *B* is attached to a point sufficiently rigid to overcome the force. The use of the torsional spring in the wire is shown in Fig. 270.

If we have bands upon the canines to which a wire has been soldered, we can tip one canine mesially or distally or in some instances, one mesially and the other distally. This movement is accomplished by putting a torsional spring in the wire as illustrated in Fig. 270. The heavy shaded lines, perpendicular and cross lines, represent the position of the canines which have been banded and connected by a labial wire. If it is desired to tip the right canine forward as represented by *B* and have a distal movement of the apex of the tooth, the wire-stretching pliers *A* is placed on the wire in the position shown at *1*. As the pinch is made, the handles of the pliers are rotated occlusally, effecting a torsional bend in the wire represented by the arrow between *1* and *2*. Between the points *A* and *B* a dead bend is made in the wire owing to

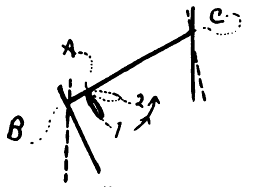

Fig. 270.

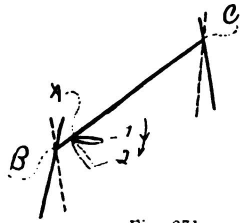

Fig. 271.

the short distance between the pinch and the soldered attachment. Between *A* and *C* a torsional spring is made which being a live spring causes that portion of the wire to return to its original shape, and the canine *B* is moved to the position represented by the dash line. There is an equal force exerted on the canine *C* which would have a tendency to tip that tooth in the position shown by the dash line.

In studying Fig. 270, it must be borne in mind that this movement occurs because of the fact that in rotating the pliers *A* from *1* to *2* a dead bend is made between *A* and *B*, while between *A* and *C* we have an active spring, or an active bend, which contains a spring force, that results in a portion of the wire from *A* to *C* returning to its original position; and in order for it to return to its original position, owing to the dead bend between *A* and *B*, the canine *B* must be rotated according to the position shown in the dash line.

If we should desire to tip the crown distally and the apex mesially or forward, it can be accomplished by means of the pinched wire and using

the pliers as illustrated in Fig. 271. In this case the beaks of the pliers *A* are placed in the position shown at *1* and as the pinch is made, the handles of the pliers are rotated gingivally, which results in a dead bend between *A* and *B*, and an active torsional spring between *A* and *C*. As the active spring returns to its original shape and as the point between *A* and *B* is a dead bend, the canine *B* is made to assume the position shown by the dotted line. An opposite force is exerted on the other end of the appliance *C* which has a tendency to change the canine *C* in the opposite direction to *B*. In considering the possibilities of tooth movements as a result of the torsional spring, one can readily see what a large amount of harm can be done when an operator produces a torsional spring in the alignment wire unknowingly. In using a lingual alignment wire, which has the bands upon the molars, it must be remembered that tipping of the molars bucco-lingually can be very easily accomplished by making pinches in a certain position of the alignment wire and by producing certain movements of the wire-stretching pliers during this pinching.

In Fig. 272 the heavy black line represents a lingual alignment wire which has been soldered to molar bands and the original position of the molars is represented by the black perpendicular line. Now, if the wire-stretching pliers *A* are placed in the position shown at *1* and as the pinch is made, the pliers are moved gingivally but not rotated, the result will be a change in the shape of the incisal section as represented by the dash line, which will produce a twist or a torsional spring in the premolar section represented by the arrow. As a result of this torsional spring in the premolar section, the occlusal portion of the molars will be tipped lingually and the apices will have a tendency to move buccally. In making this pinch and movement of the wire-stretching pliers as shown from *A1* to *A2*, the incisal section will assume a V-shape that is illustrated by the dash line. This bend in the incisal section will also have a tendency to narrow the lingual alignment wire in the canine region. In order to overcome this lingual narrowing in the canine region, if it is desirable to at the same time produce expansion of the canines, a series of small straight pinches must be made in the incisal portion of the arch to produce expansion which will overcome the narrowing of the lingual wire produced by the gingival bend from *1* to *2* at *A*.

Fig. 273 shows the possibility of tipping the occlusal surface of the molars buccally and the apices lingually by making the reverse movements as shown in Fig. 272. In this case, the wire-stretching pliers grasps the incisal portion of the lingual wire at *1* and as the pinch is made the wire is carried occlusally, which has a tendency to change the

incisal section of the wire as represented by the dash line and thereby produce torsion upon the premolar section as indicated by the arrows. This force moves the occlusal surface of the molars buccally and the apices lingually. While it is possible to rotate the molars by making a pinch and bend in the incisal region as shown in Fig. 273, it is preferable, if the rotation of the molars is desired, to produce that rotation by means of making a pinch in the premolar region, as shown in Fig. 274. Such change as produced in the alignment wire in Figs. 272

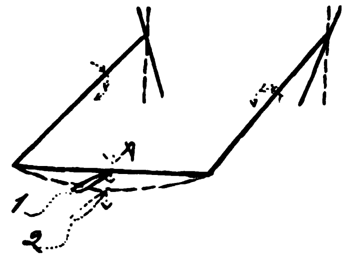

Fig. 272.

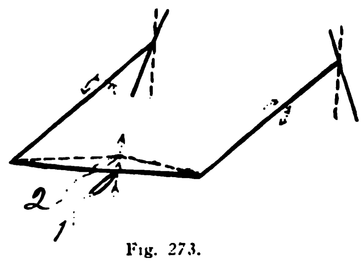

Fig. 273.

and 273 will produce a rotation or tipping of both molars, while such a pinch as made in Fig. 274 will produce a buccal or lingual movement of only one molar and produces this movement without the tendency of any change in the shape of the alignment wire in the incisal region. In Fig. 274 we again have the alignment wire represented by the heavy black line and the original position of the molars represented by the heavy

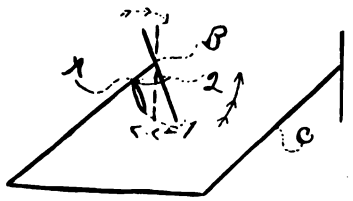

Fig. 274.

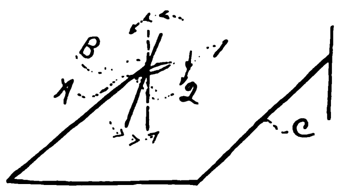

Fig. 275.

black lines. The wire-stretching pliers is placed at point *A* in the first position represented by *1,* and as the pinch is made, the handle of the pliers is rotated occlusally to position *2* as shown by the dotted outline. The direction of the movement is represented by the heavy arrow. As a result of this movement of the wire-stretching pliers a dead bend is produced in the wire between *A* and *B*. All through the remaining portion of the lingual wire from *A* around through the incisal section and the premolar section of *C*, we have an active spring which tends to

return to its original position. As the alignment wire from *A* to *C*, which possesses the active spring produced by the pinch and movement of the pliers from *1* to *2* returns to its original position, the molar *B* is tipped as shown by the dash line which is a rotation of the crown lingually and the apices buccally.

If a reverse movement of the molar is desired, or a movement where the crown is moved buccally and the apices are tipped lingually, it will

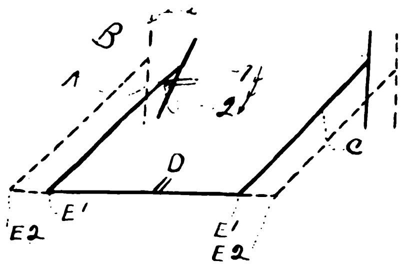

Fig. 276.

be possible to produce that movement by placing the wire-stretching pliers at the position *1* as shown in Fig. 275, and as the pinch is made, the handles are moved gingivally to the position shown at *2*. This again results in a dead bend between *A* to *B* and an active spring between *A* and *C*. As the alignment wire from *A* to *C* returns to its original shape, the crown of molar *B* will be tipped buccally, and the apices will be tipped gingivally or lingually. Fig. 276 shows the possibility of pro-

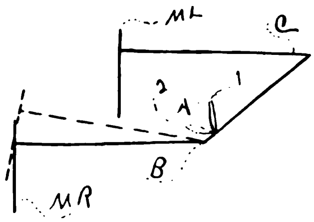

Fig. 277.

ducing a tipping of the crown of the molar buccally by means of producing a torsional spring in the premolar section of the alignment wire by the proper use of the wire-stretching pliers. In addition to this tipping of the crown of the molar buccally by making a pinch in the incisal section of the arch as shown in Fig. 276 at *D* at the section *E1* will be lengthened to *E2*, thereby producing a lateral extension of the premolars and molars. The pinch made at *A* while the handles of the pliers are

moved gingivally will result in a torsional bend which will move the crown of the right molar buccally, while the pinch at *D* will carry both molars buccally, but the one on the left side will be carried buccally without any occlusal tipping.

In some instances, it is desired to produce an elevation of one of the molars which can be accomplished according to the illustration Fig. 277. By placing the beaks of the wire-stretching pliers in the incisal section at *1* and rotating the handles gingivally to *2*, there will be produced a torsional spring in the alignment wire which will result in a change of the right side of the wire from the straight section shown at *MR* to the dash line. In other words, the molar on the right side will be elevated and there will be an equal tendency for the molar on the left side to be depressed, but owing to the difference of resistance, no movement of the left molar will occur.

The wire-stretching pliers and lingual wire present great mechanical

Fig. 278.—Lingual arches showing different styles of application. (Lourie.)

possibilities and provide a force which is capable of moving teeth in many directions if properly applied. It must also be remembered that in using the lingual arch, every pinch on the wire will produce some movement and this movement will not be noticeable until a certain length of time has elapsed.

The position of the lingual arch will vary according to the type of tooth movement that is to be desired. Fig. 278 shows the soldered lingual arch on the upper and lower teeth. In the lower dental apparatus the lingual wire is so adjusted that the pressure can be brought to bear on the lateral halves of the dental arch and on the incisors by pinching and lengthening the wire. The lingual wire on the upper teeth is adjusted for the purpose of expanding the right half of the dental arch that was in lingual occlusion to the lower teeth. It will be seen that the lingual wire on the left side rests against all of the teeth,

but on the right side, the only tooth which is receiving any force at the present time is the molar to which the lingual wire is attached. Spurs are soldered to the upper lingual wire at such point that they engage the mesial portion of the canine. These spurs can be bent distally and

Fig. 279.

Fig. 280.

Spurs used on lingual wire for the purpose of changing relation of incisors. (Lourie.)

can be made to keep the deciduous canines against the deciduous molars.

The spurs and finger springs used in conjunction with the soldered lingual wire make possible many different forms of tooth movement. Spurs can be made to fit against the gingival portions of the teeth which will allow the lingual wire to be away from the proximal spaces thereby permitting the food to pass out of the proximal space without catching on the appliance. The gingival spurs are made by filing the end of a wire flat and allowing the chisel-shaped end of the wire to

Fig. 281.

Fig. 282.

rest against the tooth. Care must be used in selecting the point on the tooth against which the spur presses in order not to produce elongation or depression of some of the teeth. Fig. 279 shows a lingual wire which occupies a gingival position and spurs and finger springs are used to ex-

ert pressure on the teeth. Pressure is exerted labially on the canines by means of two finger springs that are made from elastic gold. The flattened spurs are seen pressing against the centrals and lateral incisors, which teeth must be adjusted in the plane of occlusion. The spurs on the centrals rest on a point occlusal to the gingival marginal ridge and the spurs on the laterals are at a point gingival to the gingival margin ridge. By bending the spurs, pressure can be exerted on the central and laterals in such a manner as to produce a change in the occlusal plane as is indicated by Fig. 280.

The finger spring can also be used on the lingual arch for the purpose of moving a tooth labially that is in linguoversion. Fig. 281 shows the construction of the soldered lingual wire with the finger spring resting against the incisor that is in linguoversion. By using the wire-stretching pliers the lingual wire can be made to produce expansion of the entire dental arch. Finger springs soldered to the lingual wire can be used to

Fig. 283.

Fig. 284.

an advantage in the treatment of impacted teeth. They are made from 22-gauge elastic gold soldered to the lingual wire, the free end of the spring made into an eyelet, and attached to the impacted tooth by means of a ligature. Fig. 282 shows lingual wire with two finger springs for the correction of two impacted canines. In those cases of malocclusion where the upper arch is contracted and the canines are in labioversion the lingual arch with finger springs extending over the canines makes a very effective and inconspicuous appliance. Fig. 283 shows such a case with the appliance in place. Plain bands are made for the molar and the lingual wire should be 19-gauge iridioplatinum so it can be pinched with the wire-stretching pliers for the purpose of expanding the dental arch. The finger springs which engage the canines are made from 22-gauge elastic gold and in fitting them to the canines

the finger springs can be more easily adjusted if the bends can be made as nearly right angle bends as possible. It has been found that such a bend can be more easily adjusted than one that is curved or more nearly follows the contour of the tooth. Fig. 284 shows the canines in position as a result of the pressure from the finger springs. The lingual arch soldered to the molar bands makes a very secure attachment and offers great possibilities in anchorage. In those cases where we require expansion of only one side of the dental arch the lingual wire is soldered to the molar band and the other side is placed in a short parallel tube. Fig. 285 shows a case in which one molar is in lingual relation to the lowers and the other one is in normal position. Fig. 286 shows the occlusal view of the model with the appliance in place. By using a short tube on the malposed molar and by having the lingual wire occupying a position lingually to the

Fig. 285.

Fig. 286.

incisors, it is possible to remove the lingual wire from the tube and increase the expansion of the same. Owing to the fact that this form of lingual arch moves the tooth by elastic expansion, spring gold makes the most satisfactory appliance. In the case shown in Fig. 285 the protrusion of the anterior teeth was corrected by means of the high labial arch and finger springs. Other uses of the soldered lingual arch as well as the high labial arch will be shown under treatment.

In his technique, Mershon employs a form of attachment that enables the operator to remove the lingual arch or wire and bend it outside of the mouth in order to get the necessary force on the teeth. A plain band is fitted to the anchor tooth, the technique of making which, according to Mershon, is described on page 171. To the lingual side of the anchor band is soldered a half-round tube, which is about .10 inch in length,

as shown in Figs. 287 and 288. These bands, which are made over models in Figs. 194, 195 and 196, are then placed on a full model of the dental apparatus, as shown in Fig. 289. The construction of the lingual arch is begun by soldering a half-round spur .9 inch in length on a piece of 19-gauge wire. The premolar section of the arch extends forward to the region of the mesial surface of the first premolar or thereabouts. It is bent to fit the irregularities of the lingual surfaces of the teeth, as they occupy positions of malocclusion, as shown in Fig.

Fig. 287.

Fig. 288.

Figs. 287 and 288.—Bands with half-round tubes for use with Mershon's lingual alignment wire. (Mershon.)

290. After the premolar sections are fitted, the next step is to fit the incisor section, as shown in Fig. 291. This section is also bent to follow the teeth as they set in positions of malocclusion and is made long enough so that the distal ends will touch the mesial ends of the premolar sections. The incisal section is fitted to the lingual surfaces of the teeth at a point slightly occlusal to the gingival marginal ridge. The ends of the premolar sections and the incisal sections should meet so as to form a square end-to-end joint, as shown in Fig. 292.

This technique of making a lingual arch in three sections is employed because the lingual wire is easier to adapt in three pieces than it is to handle it as a single piece in attempting to make it conform to the irregularities of the teeth. The appearance of the different sections is shown in Fig. 293. In order to prevent the arch from being displaced and to keep the half-round spur in the half-round tube, a piece of wire of about 22-gauge is soldered to the lingual arch mesial to the half-round spur, as shown on the right side of Fig. 294. This lock is a modification

Fig. 289.—Bands placed on model of mouth. (Mershon.)

Fig. 290.—Model showing construction of premolar section of lingual wire. (Mershon.)

of what has been known in literature for the last few years as the Young-Angle lock, though similar locks were used by Barnes a great many years previously. The locking devices that are soldered only on one end are easily bent and consequently irritate the tongue. To avoid that trouble, Burrill has devised a lock soldered to each side of the spur that contains a coiled spring. This greatly increases the stability of the lock, which is shown in Fig. 295.

The completed lingual arch is shown in place in Fig. 296, which also

shows that one of the locks is bent under the half-round tube to prevent it from coming out, and that the lock of the left side has not been bent into position.

Dr. Mershon has described a technique of making the removable

Fig. 291.—Incisal section of lingual arch fitted to teeth. (Mershon.)

Fig. 292.—Incisal and premolar section in place ready for soldering. (Mershon.)

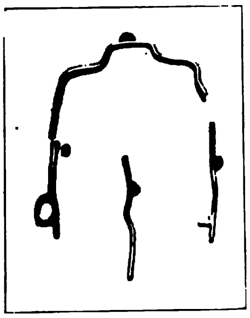

Fig. 293.—Incisal and premolar sections removed from model. (Mershon.)

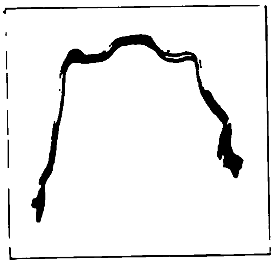

Fig. 294.—Sections of lingual wire soldered together, showing locking device. (Mershon.)

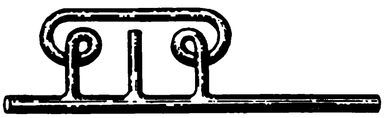

Fig. 295.—Lock for use with perpendicular tube on molar band. (Burrill.)

lingual arch from one piece of wire, which is made according to the following plan:* "Start at the half-round tube (on the molar band), allowing the arch wire to extend about one eighth of an inch, distally beyond the tube. Just mesial to the tube we make a compound bend

*The Removable Lingual Arch as an Appliance for the Treatment of Malocclusion, by John V. Mershon, International Journal of Orthodontia, iv, No. 11, p. 578.

in the wire, first to the gingiva, then again bending the wire parallel with the gingiva, and continuing along the lingual surfaces of the teeth, as close to the gingiva as possible, without impinging on it, adapting the wire to all the irregularities of the dental arch, until the tube is reached on the anchor band on the opposite side, when the arch is cut off one-eighth of an inch distal to the tube. The tubes should be placed on the lingual surface of the anchor bands, usually in the center of the band mesio-distally in both upper and lower jaws. In the lower they should be placed as near the occlusal edge of the band as possible, allowing only sufficient distance between the occlusal edge of the band and the top of the tube for the arch. This is so placed for the reason that the post is easier to place in the tube if it is not too far toward the gingiva, as it is difficult to see the tube in the lower on account of the tongue and saliva. In the upper jaw, the tube should occupy the

Fig. 296.—Completed lingual arch in position on model. (Mershon.)

same position mesio-distally, but should be placed as near the gingiva as possible, otherwise the lingual cusps of the lower molars will come in contact with the arch, and the continuous biting on it will eventually cause the arch to break. The post consists of a half-round wire soldered to the arch and accurately fitting the half-round tubes forming a portion of the lock. For convenience in soldering, a long piece of half-round wire is selected. Place the arch accurately on the model, mark the arch opposite the tubes, then solder the post to the arch opposite the mark, in the usual free-hand manner, cutting off the half-round wire just a little shorter than the tube, leaving a catch for the lock wire. Then place the half-round post wire in the tube on the molar bands on the model. If the arch should not lie correctly on the model, remove it, and with two pairs of the Young pliers it can be twisted to the desired position. Proceed in the same manner soldering the half-

round post wire on the opposite side. The arch is again replaced on the model with both pieces of the half-round post wire in the tubes. If the arch should not be well adapted or be raised away from the model, direct the flame of the blow pipe on the arch, heating it to a cherry red, and while hot, pressing with a suitable instrument on the arch it can be readily adapted to the model. The lock consists of a wire of suitable size, soldered to the gingival surface of the arch, twenty one-hundredths of an inch mesial to the half-round post passing it distally to catch under the gingival surface of the tube, thereby preventing

Fig. 297. (Mershon.)

Fig. 298. (Mershon.)

the post coming out of the tube. After polishing, the arch is now ready to place in the mouth. Remove the anchor bands from the plaster model and cement them on the teeth. In trying the arch in the mouth, grasp the arch on the left side in the region of the half-round post, with a pair of How pliers, and place the post in the tube on the left side. The arch should lie in its proper position, with the half-round post on the opposite side parallel with the half-round tube. Should it not fit properly (Fig. 297), twist or bend the arch until it lies correctly. Remove the post from the tube on the left side, then place post on the

right side in the tube. If the post on the left side drops in place in the tube, then the arch is ready to be locked in place (Fig. 298)."

Owing to the accuracy with which the half-round spurs fit the half-round tubes and to the large amount of elasticity that is obtained from this type of appliance, great care must be observed in adjusting it correctly in order to avoid unnecessary pain and discomfort to the patient and also to avoid the displacement of the molar teeth. The spurs are placed in the half-round tubes without any pressure at first. When the appliance is removed for bending in order that pressure may be

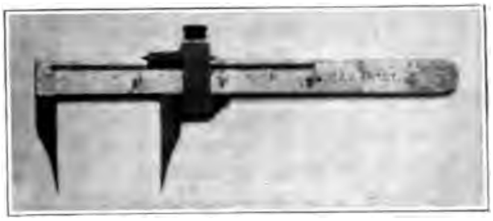

Fig. 299.—Calipers suggested by Dr. C. A. Hawley.

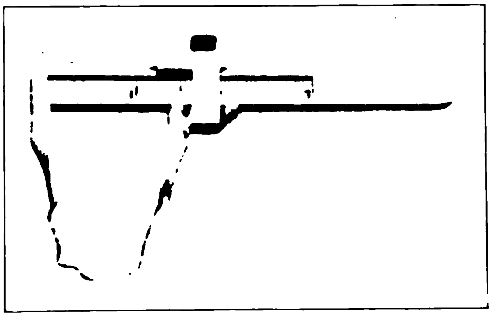

Fig. 300.—Hawley's calipers used in the measurement of lingual arch between molars. (Mershon.)

exerted on the teeth, a careful measurement is made of the distance between the half-round spurs by using a pair of calipers, as shown in Fig. 299. These calipers were suggested by Hawley for measuring the mesio-distal diameter of teeth, and are very useful in adjusting the lingual arch. After the measurement has been obtained, the calipers are set at that point and the changes are made in the bends of the arch to exert force on the irregular teeth, after which the distance between the molars is checked up with the calipers, as shown in Fig. 300.

In using the removable lingual arch, it must be remembered that

force can be exerted upon the teeth in three different ways: first by straightening out the bends and curves in alignment wire which are produced when the arch is fitted to the irregularities of teeth; second by pinching the wire in the straight portions of the alignment wire in order to lengthen it; and third by the use of elastic finger springs. In pinching the lingual wire with the wire-stretching pliers to lengthen it, we use the same principle as applied in the soldered lingual arch, which has been described previously. The other methods, those of straightening out the bends in the lingual arch so it exerts pressure on the malposed teeth, and the use of finger springs, have been worked out by Dr. Mershon. Finger springs can be used to exert pressure on one

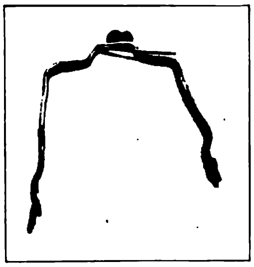

Fig. 301.—Extension spring soldered on lingual arch to increase action on tooth. (Mershon.)

Fig. 302. (Mershon.)

or more teeth and thereby give a greater range of elasticity than is possible with a plain lingual arch. These finger springs can be made to exert pressure on one or more teeth, and are attached to the lingual wire as shown in Fig. 301. Such finger springs are generally placed on the gingival side of the lingual alignment wire, and are made of spring gold which exerts a delicate and positive force upon the teeth. These finger springs can also be shaped for the purpose of moving teeth mesially or distally as is shown in Fig. 302 where the pressure is exerted on the first premolar for the purpose of moving it distally and also correcting torsiversion. By extending the finger springs over the

occlusal embrasure of the teeth, pressure can be brought to bear on the labial side of the tooth and correct torsiversion without the use of bands and ligatures. Such an application of the finger spring is shown in Figs. 303 and 304.

In certain types of malocclusion where it is desirable to move a tooth lingually and also rotate it, it may be necessary to employ the use of a band with an auxiliary finger spring as is shown in Fig. 305. We also find that finger springs are very useful in opening space for impacted teeth, and in such instances it becomes necessary to employ two finger springs as shown in Fig. 306. These finger springs are soldered to the

Fig. 303. (Mershon.)

Fig. 304. (Mershon.)

arch the width of a tooth distal to the place you wish to open up and the other one soldered the width of a tooth mesial to the space, thereby making two springs which work in opposite directions and which open up the space for the impacted tooth. The spring which is most distal is curved mesially to engage one tooth, while the spring which is mesial, is curved distally to engage the other tooth. These springs have the ends flattened if necessary to go into the proximal space and consequently exerting pressure in opposite directions becomes a form of reciprocal anchorage which is very valuable in this type of tooth movement. These finger springs are made of a material that possesses a great amount of elasticity, known as high fusing clasp metal or elastic gold

of about 22 gauge. They should be soldered to the lingual base wire with a low fusing solder in order to avoid overheating which destroys the elastic metal, and makes the finger spring break quite easily. By employing the finger springs it is possible to correct much more complicated malocclusions than could be corrected by using the lingual arch alone. In using the removable lingual arch the half-round post which engages the half-round tube on the molar band makes possible

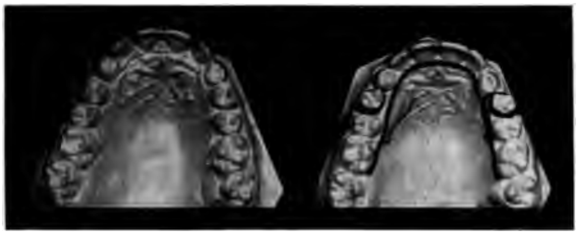

Fig. 305. (Mershon)

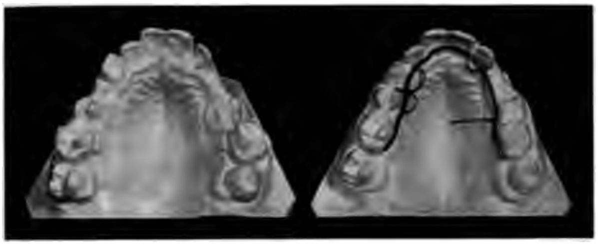

Fig. 306. (Mershon.)

any type of molar movement or rotation that is desirable, by simply bending the alignment wire in such a manner as to change the direction in which the half-round post goes into the tube. In fact, in adjusting the removable lingual alignment wire great care must be exercised in using the half-round post to always have it fit accurately in exactly the manner desired or the molar will sometimes be rotated into undesirable positions.

Appliances for the Bodily Movement of Teeth

Appliances designed for the bodily movement of teeth have been used for many years. One of the early types has been described by Case under the name of the contouring appliance. Since that time different styles have been placed on the market that possess more or less value.

The principle embodied in all types of appliances for the bodily movement of teeth, or the movement of the apex more than the crown, or the movement of the crown in one direction and the root in the other, is that of two-point attachment.

Case's appliance consists of two arches or wires that are so attached to the teeth that one will exert force at one point in one direction and the other will exert force at another point in the opposite direction.

An appliance for the bodily movement of teeth has been suggested by Angle, and called the *pin and tube appliance*. It consists of small gauge tubes soldered to bands that are placed on the teeth to be moved. The alignment wire is of small gauge, .03 inch in diameter, which gives great

Fig. 307.—Angle's pin and tube appliance. (Ketcham.)

elasticity. The small pins that engage the tubes on the bands are soldered to the alignment wire with hard solder, and care must be employed to avoid overheating of the parts. If too much solder is used, the pin will not properly engage the tube. A catch is made on the gingival end of the pin to engage the gingival part of the tube. The band should be sufficiently wider than the length of the tube so that there will be enough width of band occlusally to the tube for the arch to lie on, thus keeping it from contact with the tooth. Fig. 307 shows the Angle appliance in place on the teeth. To enable the parallel tubes to be used with the perpendicular tubes on the molar bands, the arch is made in three sections—the screw sections and the middle section. The screw

sections and the middle section have telescoping ends, as shown in Fig. 307.

The use of the pin and tube in conjunction with a small labial wire of .0225 inch has been described by Suggett,* as follows:

"Take a piece of wire, of platinum-gold, about six inches long, and with pliers (Fig. 308) bend the end as shown in Fig. 309. Then place this right angle in the left molar tube, and after getting the length of

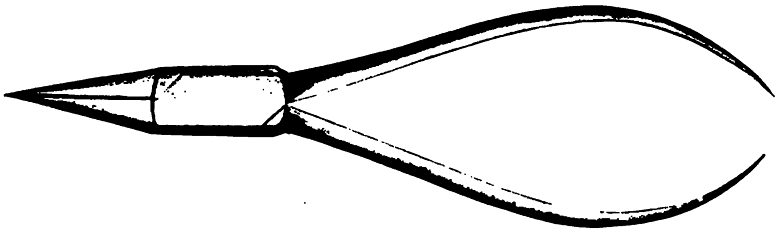

Fig. 308.—Sharp-nosed pliers for bending .0225 wire. (Suggett.)

the loop, make a scratch on the wire to indicate where the next pin should be soldered (Fig. 310). Pins 3-16 inch long, cut from the same .0225 wire, with a small sliver of 16 karat gold solder melted to one end, should be at hand ready for use. Dip the end of this pin in flux, and solder it to the wire as indicated by the scratch. A jig, or any other

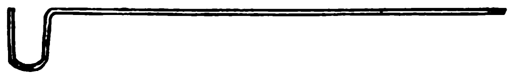

Fig. 309.—After first bend is made in wire. (Suggett.)

Fig. 310.—Second step. (Suggett.)

mechanical apparatus, is absolutely unnecessary, unless the operator is rather shaky. The jig was thought to be necessary when using the stiff .030 wire, which was too rigid to bend and adjust if the pin was not absolutely in the correct position. In making the loop just distal to the cuspid, shape it so that it will act as a hook for the intermaxillary anchorage. Either do this, or solder a small piece of wire for this purpose. Make your next loop and get your measurement for the next pin, as

*Suggett, A. H.: The Use of .0225 Alignment Wire, International Journal of Orthodontia, February, 1917, vol. iii, p. 105.

before, but provide for the rotation of the centrals and laterals as shown in Figs. 311 and 312, where the loop rests on the mesial corner of these teeth. After boiling the appliance and slightly bending the pins so that they will bind in the tubes, and shaping it to as near an ideal curve as practicable, it is ready to slip in place. There is no need of adjust-

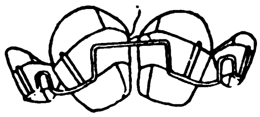

Fig. 311.

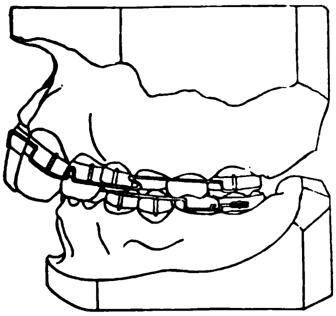

Fig. 312.

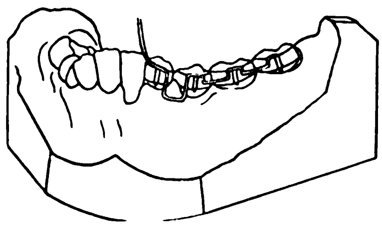

Fig. 313.

Figs. 311, 312 and 313.—Adjustment of .0225 alignment wire. (Suggett.)

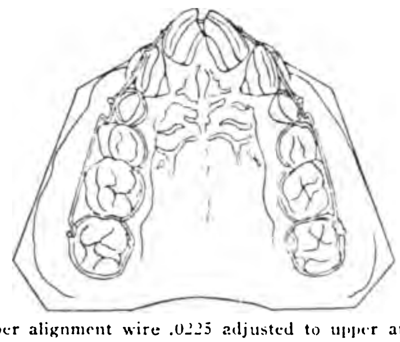

Fig. 314.—Upper alignment wire .0225 adjusted to upper arch. (Suggett.)

ing it again for several months, and possibly not at all, for there are the hooks for intermaxillary anchorage, the spring for the necessary expansion, and the upward spring necessary to carry the incisors upward and reduce the excessive overbite, as shown in Fig. 312. In attaching the lower, the close bite of the molars presents another problem. The

pins and tubes are indicated, but it is an ideal place for the Robinson attachment, which requires less vertical room (Fig. 312). The molar bands are fitted just as the upper molar bands were, with lingual spurs to carry out the deciduous molars. All the other teeth on the lower arch are banded and tubed, and the wire and tubes adjusted just the same as on the upper, except for the Robinson attachment on the molars, and that the wire is not sprung in to attach to the right lateral, but a rubber is looped over it until it is a little nearer the line, when the pin can be slipped into the tube and the root movement is made in unison with the others (Fig. 313). A hook for intermaxillary anchorage is soldered on the wire just anterior to the molar attachment, and this arch wire is ready to slip into place (Fig. 312). Fig. 314 shows the occlusal view of the upper."

The use of small gauge wire for the bodily movement of teeth was advocated by Robinson* and described in clinics and in papers that he

Fig. 315.—One style of Robinson's .022 alignment wire.

gave before various societies. He described the various forms of appliances that can be used for the bodily movement of teeth, as follows:

"The appliance was first made with short, split, round tubing soldered to the labial surfaces of the incisor bands near the gingival line. The arch made of .022 inch wire was threaded at its ends, which were placed in tubes on the molar bands. The arch wire was engaged in the short split tubes, and at the points where it emerged, was bent sharply toward the incisal edge. It was allowed to extend nearly to the cutting edge, and was then bent at right angles and passed to the next tooth, when it was bent at right angles again toward the gingival line. When it reached the line of the split tubing, it was bent again at right angles and passed through the next tubing and so on for each tooth (Fig. 315). By proper bending of the wire, pressure could be brought to bear on the incisal ends of the teeth in the lingual direction, and at the same

*Robinson, R. D.: A System of Positive and Painless Tooth Movement. International Journal of Orthodontia, October, 1915, vol. i, p. 397.

time it would pull labially on the gingival portion of the tooth. In this way the apices of the roots were moved labially, and the incisal ends lingually. The appliance as described, did very good work in certain instances, but its usefulness was restricted to a very small percentage of cases. The things of greatest interest learned were the length of time such an appliance would continue its pressure, and the absence of all soreness. After this, came the thought that better control could be secured if the rotation of the arch wire in the tubing could be prevented. To this end square split tubing was secured, and a square wire used, but a new difficulty immediately arose. When the wire was made into loops, it was found that no two loops had the same resistance, for a square wire bent in the direction of one side will not have the same

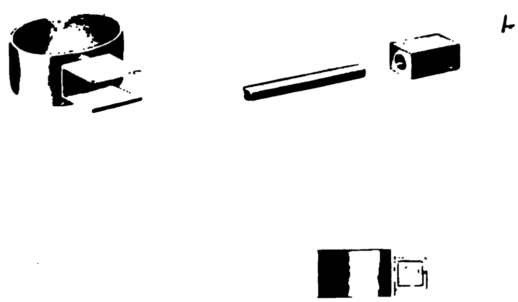

Fig. 316.—Robinson's blocks and seals for use with the .022 alignment wire.

resistance as though it is bent in the direction of a corner, and all the different angles between the flat side and the corner give different results. A triangular wire was then tried, then a flat wire with a groove on one side to provide means for locking into a suitable form milled from solid metal and soldered to the tooth bands, but they all presented difficulties. Then came the idea of squaring a round wire just at the points where it was to be locked to the bands. When a wire small enough to give just the right delicate resilience required for the work was squared, the squared portion was too small to handle, and when it was made large enough to handle, it was too stiff to give the results desired. After a period of study, came the idea of using hollow square blocks soldered on the arch wire at the places where the attachments were to be made (Fig. 316). That was the first real step in developing the present ap-

pliance. The ability to lock the arch wire itself into the seats without soldering on attachments was at first held by the essayist to be a necessity, but after once preparing an arch in this way, it developed that the technique is so simple as to bother no one. The possibility of making an error in alignment in soldering the block to the arch is practically nil, and the advantage gained is so great that there can be no question

Fig. 317.—Robinson's appliance adjusted to upper arch.

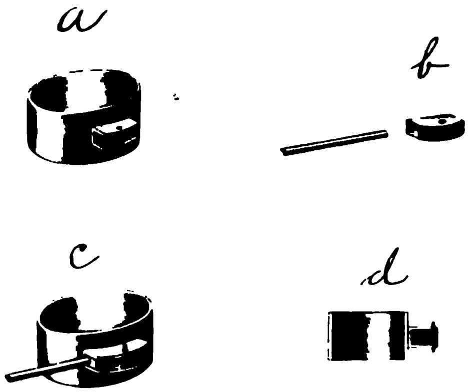

Fig. 318.—Robinson's interlocking slat.

that the use of the round wire and the soldered blocks will be accepted as more desirable than the use of the angular wire. Iridio-platinum seats into which the blocks accurately fitted, were constructed and soldered to the tooth bands. When the blocks were soldered to the arch wire and locked into the seats by bending their edges, the attachment between the arch wire and tooth was rigid (Fig. 317). The appliance

was first published in this form, and much good work was done with it as it was then used, but a serious fault developed. When the seat was made thin enough to bend over and lock the block in place, it was so frail that it often became loose under continued pressure and the stress of mastication, allowing the block and arch wire to slip, and thus the force was not applied as it should have been.

"The attachment between the tooth and the arch was then made by an interlocking seat (Fig. 318-*a*) and block (Fig. 318-*b*), the former being soldered to the tooth band, and the latter to the arch wire. The seat consists of a flat oblong base and two flat parallel walls rising at right angles to the base. The walls are rounded at the top, and each is pierced near the top with a small hole, the two holes being in alignment. The seat is made of platinum-gold and is .022 inch thick. The distance between the walls or across the base of the seat is .040 inch.

"The block is of platinum-gold, but harder than the seat, and is .040 inch thick and shaped to fit inside the walls of the seat above described, except that it is .005 inch greater in elevation than the side walls of the seat, which provides means for its being forced into the seat, with a pair of pliers, when there is stress on the arch wire to which it is soldered. The block (Fig. 318-*b*) is pierced by two holes, the larger runs longitudinally and its bore is equal to the diameter of the arch wire used, or .020 inch. The smaller hole is through the transverse diameter of the block near the top and is in the exact place to be brought into alignment with the two holes in the seat walls when the block is forced into place in the seat. The block is locked into the seat by placing a delicate pin through the seat walls and the block (Fig. 318-*d*). When so locked, no play is possible. The two parts are made to fit to the minutest fraction of an inch, and as they have three flat walls in apposition, and are locked firmly together, they do not permit of any play whatever. The molar and anterior attachments are alike, except that the molars are the longer (Fig. 318-*c*.)

"The technique of construction is very simple. The tooth bands are first constructed, and to their labial surfaces are soldered the seats (Fig. 319). No necessity exists for getting them into alignment with each other, or of getting them at exactly right angles to the long axes of the teeth. If they be placed somewhere nearly at right angles it will be sufficient. After the bands with the seats attached have been cemented to the teeth, the arch wire is prepared as follows: A piece of arch wire is selected and enough blocks to correspond with the number of tooth bands are threaded on the wire; a molar block being first and last with the anterior blocks between. One of the molar blocks is now soldered to the

wire. The block is next introduced into the seat in the mouth and the arch wire is bent in such a way as to bring it to lie through the next seat. If there is to be any change made in the relative position of the molar and the first tooth to be engaged, anterior to it, a loop should be made in the wire in such a position that it will lie near, without touching, the gum, and then bring the wire to lie through the next seat. When this has been done, bring forward the next block on the wire until it is approximately in the proper place to go into the seat. Next, with a pair of crimping pliers having a delicate projection in one beak, crimp the block on the wire; now the block may be forced into the seat and if not in its proper place on the wire, it can be forced into place by grasping the ends of the seat and block in a pair of pliers and bringing force to bear. As they are exactly the same length, the block must go to its proper place. The arch wire is now removed from the mouth and

Fig. 319.—Showing construction of Robinson's appliance.

the block soldered, there being little danger of displacing the block on the wire because after crimping the block, force must be used to change its position on the wire. Each block is, in its turn, brought to its proper place and soldered in a like manner, loops being formed wherever necessary. After the last block has been soldered, any remaining portion of the wire is cut off. It will now be found that when the arch is placed in position each block will lie passively in its seat (Fig. 320). When the work required of the arch wire has been determined, it is bent into the necessary form and is then replaced in the mouth and each block is forced into its corresponding seat and locked there."

The bodily movement of teeth by the use of a seat and flat arch has been described by Angle under the trade name of the "ribbon arch". It has features very similar to Robinson's appliances in that it makes use of a seat that is termed a bracket, an enlarged view of which is shown in Fig. 321. The ribbon arch fits into the bracket, as shown in Fig. 322. A small hole in the bracket admits of the passage of a

small pin, which locks the arch in place. The pin is made with a small head that engages the ribbon arch and does not pass through the arch at all. The bracket is made on the band, and the band is fitted to the teeth by pinching the strip of band material that carries the bracket around the tooth, and then it is soldered. It is needless to say that the seam of the band is always made on the lingual side. Fig. 323 shows

Fig. 320.—Robinson's alignment wire with blocks in seats.

how the appliance appears when adjusted in the mouth. In the correction of torsiversion, the appliance is employed as shown in Fig. 324. The ribbon arch is a one-piece arch, the ends of which are flattened and fit into curved tubes on the molars' bands, as shown in Fig. 325. This gives a greater degree of stability and prevents the alignment wire or ribbon arch from turning in the tube. The buccal tube is also curved to follow the convexity of the buccal surface of the molar, which places the distal end of the tube out of the way of the cheek much better than

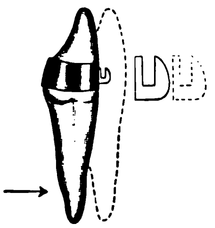

Fig. 321.—Angle's bracket band. (Courtesy of S. S. White.)

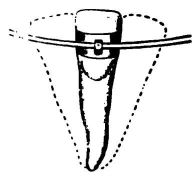

Fig. 322.—Ribbon arch in bracket of Angle band. (Courtesy of S. S. White.)

does a straight tube. The bracket can be turned toward the occlusal or towards the gingival part of the tooth, depending upon what is to be done and upon how the appliance is to be used. In Fig. 325 the appliance is adjusted in a case of distoclusion, and in Fig. 326 in a case of mesioclusion.

Flat arches with flat or oval tubes for the bodily movement of molars are also in use, one style of which is shown in Fig. 327. Another style of

Fig. 323.—Angle's ribbon arch adjusted to the teeth.

Fig. 324.—Angle's ribbon arch adjusted to correct torsiversion.

Fig. 325.—Ribbon arch and brackets adjusted for the treatment of distoclusion.

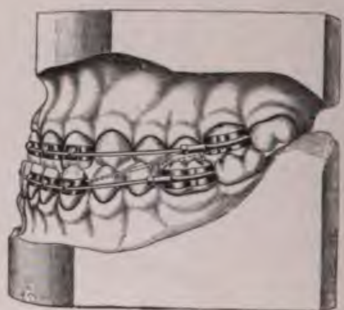

Fig. 326.—Ribbon arch and brackets adjusted for treatment of mesioclusion.

Fig. 327.—Julius Aderer's clamp band for bodily movement of molars.

Fig. 328.—Brady's clamp band for anchorage and use with alignment wires.

molar band that can be used with any form of attachment, either for the bodily movement of teeth or otherwise, has been designed by Brady, and is shown in Fig. 328.

The Lingual Arch Used in Connection With the Labial Arch

The type of appliance that possesses many advantages over the majority of other appliances is the lingual arch or wire supplemented with the labial arch or wire for use in some kinds of cases. The use of the labial and lingual arch produces the bodily movement of the teeth, and in most instances this movement can be produced without the use of any bands, which make the appliance much less conspicuous than it would be otherwise. There are various combinations of the labial and

Fig. 329.—Early form of labial and lingual arch. (Lourie.)

lingual appliances, one of the earliest forms being that shown in Fig. 329. Bands are placed on the first molars and the lingual arch is fitted to the lingual surfaces of the teeth. In a great many cases the lingual arch is not fitted at the gingival border of the teeth as shown in this figure. The lingual arch exerts an outward pressure on the teeth at the gingival portion. On the buccal surface of the bands are soldered molar tubes, which receive the labial appliance, as shown in Fig. 330. This labial wire carries extension spurs, which rest against the labial surfaces of the incisors at such points as it is desired to bring pressure. If it is desired to continue wearing the labial wire at night as a retaining appliance, it can be removed in the daytime and placed on a modeling compound form, as shown in Fig. 331. As long as the labial wire fits the form accurately, it will exert the proper force on the teeth when

it is replaced. Should the labial wire become bent, the patient is instructed to have it readjusted by the orthodontist.

The combination of the lingual arch with the labial arch has many advantages in the bodily movement of teeth. Fig. 332 shows the adjust-

Fig. 330.—Front view of labial arch in combination with lingual. (Lourie.)

Fig. 331.—Modeling compound form to maintain shape of labial arch when not on teeth. (Lourie.)

Fig. 332.—Lingual arch adjusted with buccal tubes on molar bands to receive labial arch. (Lourie.)

ment of the lingual arch with bands on the molars. The lingual arch can be made to serve the purpose of expanding the dental arch and at the same time acting as an anchorage, while the labial arch is producing the bodily movement of the lateral incisors and the distal movement

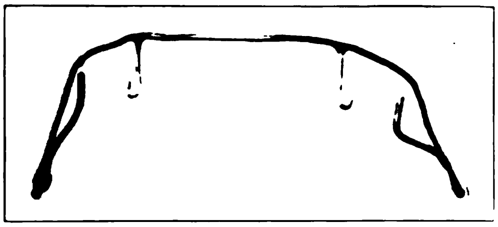

Fig. 333.—Labial wire with spring extensions for use with lingual arch. (Lourie.)

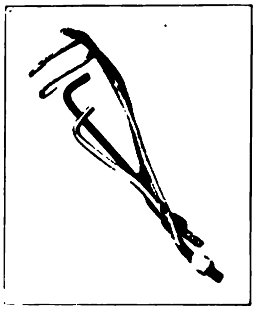

Fig. 334.—Labial wire with extensions to canines. (Lourie.)

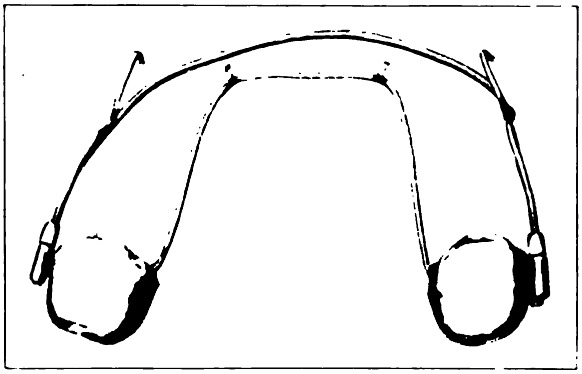

Fig. 335.—Labial and lingual arch in combination. (Lourie.)

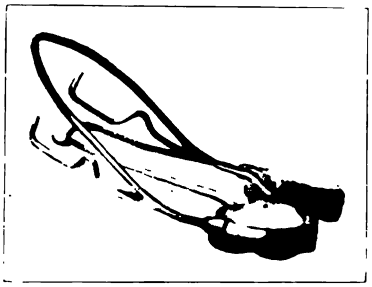

Fig. 336.—Labial and lingual arch in combination showing spring extensions for canines. (Lourie.)

of the canines, as well as the depression and rotation of the canine.

The molar bands carry buccal tubes, to which is fitted the labial arch, shown in Fig. 333. Bands are placed on the lateral incisors, which carry small perpendicular tubes of 22-gauge on the inside. At the proper point on the labial arch, which has been fitted above the gingival

margin of the teeth to make it less conspicuous, are soldered 22-gauge spurs of spring gold, the ends of which are bent so as to pass into the tube from the occlusal edge. This gives a greater length of spur and thereby increases its elasticity, and the bent occlusal end enables the tooth to be rotated by bending the horizontal part of the bend. The extension springs soldered to the labial arch just in front of the screw on the labial arch have their anterior ends bent at right angles, which are received into tubes on bands that have been placed on the canines. A

Fig. 337.—Labial wire applied gingivally to avoid conspicuousness. (Lourie.)

Fig. 338.—Labial wire with spring extensions. (Lourie.)

side view of the appliance is shown in Fig. 334. The labial arch is fastened in position by means of a traction cable that is tied around the distal end of the tube and in front of the nut. Should the appliance exert enough force to make the teeth sore, instruction is given to cut the string and remove the appliance.

Another form of the lingual and labial arch in combination is shown in Figs. 335 and 336. Spurs have been soldered to the lingual arch to engage the gingival part of the upper lateral incisors, thereby exerting

Fig. 339.

Fig. 340.

force nearer the neck of the tooth; and they can also be made to exert a downward pressure if the tooth is in infra-occlusion.

A more recent adoption of the combination of the labial arch with the lingual is seen in Figs. 337 and 338. Fig. 337 shows the bands on the first molars to which the lingual arch has been soldered. The lingual arch is placed gingivally to the free margin of the gum and lies far enough toward the apical portion of the teeth so that there is no chance that the lingual wire will hold food against the tissue. Spur extensions are soldered at suitable points on the lingual wire to exert pressure on the desired teeth. These spurs are so bent that they will not impinge on the gum tissue and will still exert force against the necks of the teeth. By pinching these spurs between the beaks of the wire stretchers they can be lengthened, and force can be exerted upon the individual teeth without disturbing any of the other teeth. Tubes are soldered on the buccal surfaces of the molar bands for the purpose of carrying the labial

Fig. 341.

Fig. 342.

arch. This arch is made from 17-gauge iridio-platinum or gold and platinum to which is soldered 22-gauge elastic gold extension spurs for the purpose of exerting force on the cutting edge of the incisors and producing a bodily tooth movement.

Fig. 338 shows the high labial arch with spring extension for the purpose of exerting a lingual pressure on the anterior teeth. The high labial arch can also be used with the recurved or J extension as shown in Fig. 333. This form of extension is employed for the correction of torsiversion or for the bodily movement of the tooth or for both forms of tooth movement. Fig. 339 shows the high labial arch with recurved extensions which are fitted into perpendicular tubes soldered on the band fitted to the lateral incisors. By adjusting the position of the recurved portion of the J extension which goes into the perpendicular tube, it is possible to get any tooth movement desired. Fig. 340 shows how in-

conspicuous the entire appliance is when the lip is in position. The high labial arch when used without the lingual arch also provides an excellent appliance for the expansion of the arch in the molar and premolar region, either when a bodily movement of the molars is required or when only a movement of the crown is desired. Fig. 341 shows the construction of a high labial arch on a typodont, for the purpose of expansion in the molar and premolar region. On the molar is a round buccal tube which is the same gauge as the labial alignment wire, 17- or 18-gauge being the best size to use. A band is made for the first premolar which has soldered to it a short tube of 22-gauge. The tube on the premolar band must be parallel with the tube on the molar band occluso-gingivally. The labial arch is fitted as shown in Fig. 341. If it is desired to increase the expansion in the molar region, the portion of the labial wire that goes into the buccal tubes is moved buccally by bending the perpendicular part of labial wire buccally. This places

Fig. 343.

Fig. 344.

a buccal expansion on the molars without any tendency to rotate the distal portion of the molar buccal as so often happens when expansion is produced by increasing the spring in the old style labial alignment wire.

Soldered to the labial alignment wire in the premolar region just anterior to a point corresponding to the mesial end of the tube on the premolar band is a 22-gauge spring extension, the occlusion portion of which is bent into an L with the parallel portion of the end pointing distally. This spring extension is for the purpose of expansion of the premolars and provides the necessary force without changing the shape of the labial wire. In order to move the second premolar and canine buccally without any extra attachment a lingual spur is soldered to the premolar band to engage the canine and second premolar. These two attachments are all that is needed to control the expansion of the lateral

halves of the arches, and provides a secure attachment and one easily adjusted. Fig. 342 shows the occlusal view of the appliance. In some cases it is desirable to place the band on the canines instead of on the premolars. The lingual extension soldered on the canine band can be made to engage the lateral incisor and with a lingual extension on the molar band we have control of all of the teeth except the central incisors with but two attachments on the labial wire. No ligatures are used and the attachments are far enough apart so as to allow individual tooth movement and adjustment. Fig. 343 shows the buccal view of the appliance and Fig. 344 the occlusal view. In using the lingual arch in combination with the high labial arch it must be remembered that the lingual arch can be used to stabilize the anchor teeth, in which case all of the force to correct the malposed teeth is derived from the labial

Fig. 345.—View of labial wire in use showing inconspicuousness. (Lourie.)

arch or the lingual arch can be used to stabilize the molar and also used as an appliance for expansion in the premolar and canine region. In the latter form the labial arch and finger springs exert force on the anterior teeth and are used in this manner in distoclusion with protruding anterior maxillary teeth.

The combination of the labial and lingual arches makes an appliance that renders any form of tooth movement possible and one that is less conspicuous than any other type of appliance that is capable of producing as wide a range of movement. Fig. 345 shows that the extension spurs are the only part of the appliance that is visible. Other uses of the lingual arch with its combinations will be shown in the treatment of cases.

CHAPTER VI

REMOVABLE REGULATING APPLIANCES

Regulating appliances are mechanical devices for exerting force upon malposed teeth for the purpose of creating cell activity and thereby causing the teeth to assume a proper position in the line of occlusion. These appliances are divided into fixed and removable. The fixed appliance has been described in a previous chapter of this book. The removable appliances will be considered here because they possess a great many advantages that are not possessed by the fixed appliances and embody mechanical principles that should be understood by all who are interested in the practice of orthodontia.

The early types of removable regulating appliances were necessarily crude, although they possessed certain features which recommended them for use in the treatment of malocclusion. The very early appliance embodied some form of spring force which exerted a mild constant, painless pressure, but the purpose of this pressure was often defeated by the fact that the appliance was very unstable and very difficult to keep in position. It is through the work of Victor H. Jackson that removable regulating appliances have been brought up to their present standard. We can now say that it is practically possible to treat any type of malocclusion with the removable regulating appliance that can be treated with a fixed appliance.

A number of varieties of malocclusion can be more successfully and more easily treated from the patient's standpoint with the removable appliance than if treated with some of the fixed forms of appliances which are on the market.

The early type of removable regulating appliance consisted of some form of a plate, force being exerted by means of a spring. The Coffin split spring plate which is shown in Fig. 346 was this type of appliance and consisted of a split vulcanite plate covering the palate, touching only the lingual surfaces of the teeth and relying upon the lingual surfaces for retention. It has the double loop spring of 18-gauge steel or piano wire which, when the plate was removed from the mouth, could be bent buccally, causing a spring force for the expansion of the arch when the plate was snapped back in position. This plate was very satisfactory in accomplishing the expansion of

the upper dental arch but was not so satisfactory if individual tooth movement was required. The plate also possessed very insecure anchorage and to overcome this insecure attachment Jackson's earliest appliances consisted of the addition of wire clasps made to cross the occlusal surface of the interproximal occlusal groove and fitted to the bucco-cervical border, thereby giving a greater resistance and attachment to the removable appliance than was obtained with the plain vulcanite plate.

Fig. 347-A shows the construction of a plate with encircling clasps around the molars, and Fig. 347-B shows the same construction of the plate with clasps encircling both the molars and premolars. The use of these clasps tended to eliminate the bulky portion of the plate over the occlusal surface of the teeth and rendered the appliance much more cleanly and greatly increased its stability. After the clasp was employed for the use of the vulcanite plate, it was then used with an

Fig. 346. Type of Coffin's split spring plate.

all-metal device and the clasp so constructed as to be connected across the palate with wires from which springs were to be extended the same as in the vulcanite (Fig. 348).

The original design of the Jackson all-metal removable appliances was limited to various tooth movements but the great range of these designs soon made it possible for a system to be perfected, governed by definite principles, and limited only by the ingenuity of the designer, for the correction of all classes of irregularities.

The Jackson system of removable appliances reached a stage of perfection between 1899 and 1900, which resulted in their taking the lead among removable appliances. Having mastered the technique of these appliances, Jackson obtained the most beautiful results, and most operators, who realize the superior qualities of the spring force and elimination of the many objectionable features of the fixed type,

have adopted the Jackson system. One great drawback in the use of removable appliances has been the impossibility of securing the coöperation of some patients. The fact that the removable appliance can be taken out of the mouth and the teeth cleansed has also been a

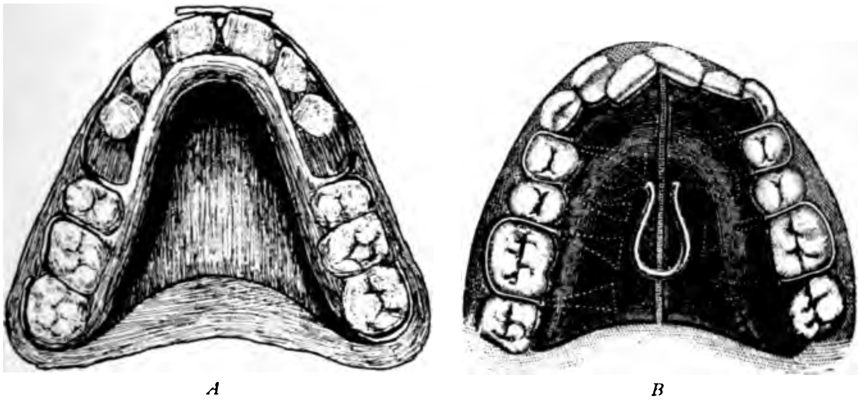

Fig. 347.—*A* shows partially encircling clasps around the molars, and *B* shows completely encircling clasps around the first bicuspids and first molars in a split spring plate. (Eby.)

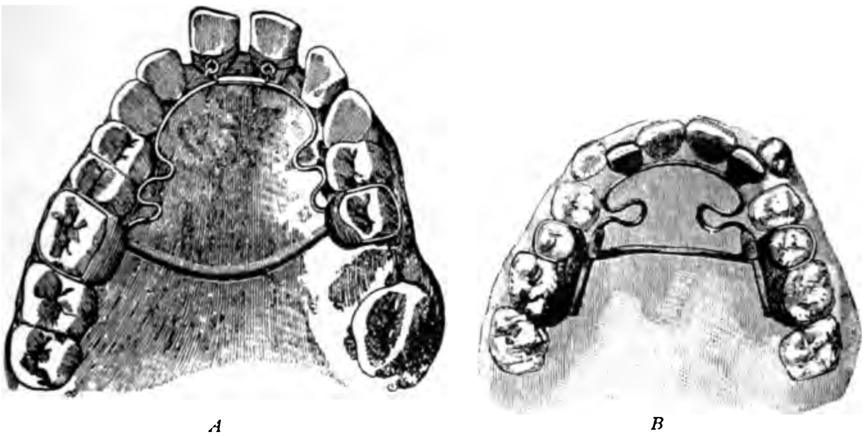

Fig. 348.—*A* and *B* show all-metal device with clasps so constructed as to be connected across the palate with wires, from which springs are extended. Early forms of Jackson's removable appliances. (Eby.)

disadvantage in the mouths of those patients who insist upon taking the appliance out and therefore interfering with the working of the appliance. However, these disadvantages have been gradually eliminated and Jackson has designed these modern appliances so that it is easy for the operator to remove them, but practically impossible

for the patient. These "removable-fixed" appliances designed by Jackson possess many advantages, but in those cases where the coöperation of the patient can be secured, it is still possible to use the simpler form of the Jackson appliance.

For the proper construction of the removable appliance it is necessary to have a certain number of instruments for the purpose of bending the wire and making the part of the appliance so that it will do what it is intended to do. The instruments required are a short, straight-ended scissors, a combination punch and contouring pliers, straight flat-ended instrument for adaptation, a wire cutter, a long-nosed pair of pliers, a very small-ended round-nosed pliers, and par-

Fig. 349.—Instruments used in technique. (Eby.)

allel pliers. These instruments are shown in Fig. 349. No pliers is better adapted to the contouring of plates and metal for the lingual surfaces of the anterior teeth than the S. S. W. pliers, No. 112. All other appliances which have been tried either undercontour or overcontour and crimp the strip, which will interfere with the metal being adapted to the convex surface of the tooth. The round-nosed pliers is used for practically all wire bending and should be very small at the end in order to make the bending more accurate. The ends of these pliers can be made small by fastening them in a vise with the jaws of the pliers closed and with a strip of emery cloth uniformly reduce the exterior diameter of the point. The parallel pliers are used for the bending of the heavy wire. Side cutters, for cutting the wire, are

indispensable. Fig. 350 shows a soldering equipment which consists of a brush burner and a one-pound pair of soldering coppers. These soldering irons should be pure copper as the composition metal iron will oxidize very rapidly, will pit, and will not control block tin accurately. Irons smaller than one pound to the pair, that is, one-half pound each, burn rapidly and do not hold heat long enough, and larger irons are more cumbersome and clumsy and require too long a time to heat. The soldering flux is a saturated solution of zinc chloride and should be applied abundantly with a camel's-hair brush.

Fig. 350.—Soldering equipment, consisting of a brush burner and a 1 pound pair of soldering coppers. (Eby.)

This solution can be better made than that which is usually bought, by pouring hydrochloric acid (C. P.) slowly over the zinc globules. The zinc should remain in excess, as the free acid will attack the metals. This solution is put in a large vessel (Fig. 350) in order that the iron may be kept perfectly tinned by emerging the point after each heating.

The first material to be mentioned for use in the construction of the Jackson appliance is Jackson's partial clasp metal, 36-gauge (Fig. 351). This is a specially prepared, stiff material, not to be annealed, which responds to the contouring pliers, but is so resistant to bend-

ing that it will not yield to stress during insertion and removal of the appliance. This material is treated on one side to cause a tenacious attachment to the tin, and it is impossible to scale off the plates when made of this special metal. All substitutes, such as low carat gold, copper, platinoid, nickel silver, or brass of many forms, cannot be used with as great success as can this metal. This metal possesses a gold surface for contact against the enamel.

The wire used in making the Jackson removable appliance is an alloy of nickel silver, as springy as possible, and also bendable. The gauges required are Nos. 20 and 21 for clasps, 18, 19 and 20 for finger

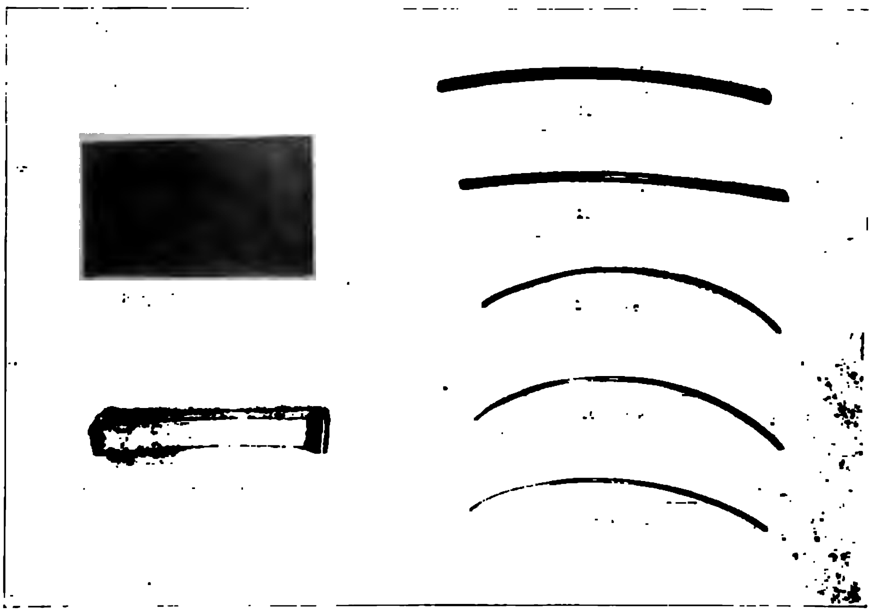

Fig. 351.—Materials used in technique. (Eby.)

springs, and 10, 11 and 12 for connecting body wires. This material can be purchased at the supply houses. The solder must be purest block tin (Fig. 351). Manufactured market block tin, which abounds in arsenic and is slightly irritating, and the best tin procurable, is the tin used in making an alloy. Half and half solder should never be used.

In the construction of the Jackson removable appliance, it is necessary that we have a perfect model showing all the anatomic outlines of the parts. These models should be made from plaster impressions, as it is necessary that all the surfaces of the teeth, including the lin-

gual and buccal surfaces, be clearly outlined. The models should be made from the finest grade of plaster of Paris. When the very hard compositions of modeling materials are used, or if the plaster of Paris is boiled in stearine or paraffin, the possibility of exercising exact technique is lost.

Models should not only be made of plain plaster, but should be used moist. When the numerous parts are made over dry plaster surfaces they have to be removed, set aside, and assembled when all parts are finished. By this plan the desired accuracy is lost because the progressive process of building one part upon another, from the first to the last, and if the parts first made are removed it is impossible to make allowance for the subsequent parts to fit over them accurately. If the model plaster is moistened, the individual parts have sufficient adherence to remain in position, allowing the advanced steps to be taken with accurate calculation of size.

As soon as the design of the appliance has been determined the next step is the carving of the cervical border of the posterior teeth selected to bear the "partial clasp" lingually and the "spring clasp" buccally. Jackson has always emphasized this point, for the security of the anchorage depends upon the use of the cervical constriction. Along the linguo-cervical borders of all posterior teeth which are to carry "partial clasps" a very thin, sharp-pointed instrument should be drawn to make a narrow groove to represent the natural space between the cervix and the gingival border of the free margin of the gum. The instrument should be inserted at an angle of approximately 35 degrees from the axis of the tooth to carve out the groove anatomically correct (Fig. 352). The bucco-cervical border of teeth to bear spring clasps must be brought out clearly by trimming away the slightest possible amount of outline of the margin of the gum. To do this the instrument should approach the surface at right angles from the axis of the tooth (Fig. 353). The surplus left between this line and the buccal surface can be carved away, thus opening a distinct outline of the bucco-cervical border to which the clasp is fitted (Fig. 354).

The next step is the construction of partial clasps. Partial clasps are made of partial clasp gold, a material especially prepared by Jackson and mentioned in the former part of this chapter. The success of the attachment of the appliance depends greatly upon the adaptation of the partial clasp to the lingual surface constriction of the anchor teeth, held in position by spring clasps buccally. As these borders

slide over the lingual surfaces during removal and insertion they would be bent outward if made of soft material, thus causing the apparatus to loosen. The strain will also cause a weak soldered connection to loosen so that the "partial clasp" will peel off, leaving only a soldered surface in loose contact with the tooth. For these two principal reasons this material has no substitute and, being the first step in the construction, failure here will result in the complete failure of the appliance. Partial clasps are to be fitted to all the posterior teeth engaged in the arms of the appliance for anchorage. They must be fitted with perfect accuracy, well into the cervical constrictions,

Fig. 352. Carving model prior to fitting partial clasps. (Eby.)

slightly beneath the free margin of the gums. However, they must not be carried far enough gingivally to interfere with the fibers of the peridental membrane and produce irritation. The ends of the partial clasps should extend to the mesial and lingual aspects of the lingual surfaces but not into the proximal surfaces. If the ends project too far interproximally, they prevent the appliance from receding, wedge the teeth, and cause painful injury to the interproximal tissue. Partial clasps should extend towards the lingual cusps slightly occlusally to the point of greatest convexity on the lingual surface but not far enough to interfere with the occlusion (Fig. 355).

Fig. 353.—Carving gingival surface of model prior to fitting of spring clasps. (Eby.)

Fig. 354.—Carving buccal surface of tooth prior to fitting spring clasp. (Eby.)

The treated surface of the metal must be faced outwards, with the pure gold surface touching the model, and this especially treated surface can be readily distinguished by the color and finish. A wider strip should always be cut for the molars than for the premolars in

Fig. 355.—Showing construction of partial clasp. (Eby.)

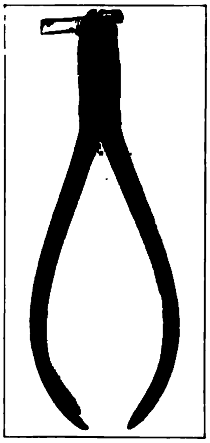

Fig. 356.—Contouring pliers used to contour partial clasp metal. (Eby.)

Fig. 357.—Pressing partial clasp into place. (Eby.)

curve of the gingival surface to any desired length. After trimming The contouring pliers (Fig. 356) will conform the strips to the double order to keep the occlusal border on a straight line mesio-distally. the cervical border to fit perfectly, the partial clasp should be carried

to place, with the curve of the plate smaller than the surface curve of the lingual of the tooth and it then can be enlarged by pressing it into position where it will remain securely (Fig. 357).

Spring clasps are divided into two forms—full and partial. The full spring clasp entirely circles the tooth, crossing from the lingual to the bucco-cervical constriction over the interproximo-occlusal groove, with both ends attached in the solder. This design is typical of the removable appliance. The partial spring clasp partially encircles the tooth only, crosses only the mesial or distal interproximo-occlusal groove, traversing the bucco-cervical constriction, terminating in the opposite proximal side whence it is crossed for attachment lingually. This clasp is used both in the fixed-removable and removable type. Two spring clasps are employed on both sides of the arch to secure balance of attachment and are usually attached on the most anterior and most posterior teeth in the arms of the appliance. Spring clasps are made of 21-gauge or 22-gauge special alloy nickel silver wire. No. 21-gauge is generally indicated in all partial spring clasps and also in the full spring clasp excepting for especially large teeth. The wire should be cut into two and three-inch lengths and the bending begun in the middle to permit a free holding for bending until the clasp is complete. The clasp wire should first be bent to the curve of the gum scallop on the buccal surface with the two ends pointing occlusally to the proximal side.

After this, the second step is to bend this bucco-cervical portion into a second curve, the curve of the bucco-cervical constriction, mesiodistally. For this it is necessary to use the brace of a rubber block to control the bending accurately (Fig. 358).

The third bend requires the greatest accuracy because it forms the angle between the buccal and occlusal surfaces. If this bend is too high, it causes the occlusal portion to interfere in occlusion. If it is bent too low, the bucco-cervical region will be too short on the teeth to reach the cervical constriction. The operator should possess a medium-length left thumb nail so that it can grasp the wire accurately (Fig. 359), bringing off the wire so the end of the round-nose plier can pick up the exact point by running down over the surface of the thumb nail (Fig. 360). It is far better to continually underbend, trying to position frequently and in this way make continuous progress. By bending too far the work will be undone, started over again, and usually the part is ruined by inaccuracy and breaking by the crystallizing of the wire.

In making full spring clasps, the mesial and distal portions should be carried across the occlusal surface together, for if one side is finished first, the clasp is liable to be warped. After fitting across the occlusal surfaces, the ends are bent downward to be curved around midway of the partial clasps for soldering. The mesial end should be

Fig. 358.—Bending clasp wire on rubber block. (Eby.)

Fig. 359.—Obtaining measurement of occluso-gingival portion of clasp. (Eby.)

bent to transverse the entire length of the partial clasp distally and vice versa, so as to gain a strong "mechanical" attachment in the solder. If these ends are cut short they will pull out of the tin, which is caused by mild galvanic erosion which gradually makes ingress between the wire and the tin, loosening the adhesion a short

length around the wire at the point of entrance into the tin causing a short straight end to pull out.

It is also important to extend the end of the spring clasp wires to rest against all portions of clasps not engaged (Fig. 361). If this is not

Fig. 360.—Bending clasp around round-nosed pliers. (Eby.)

done, the attraction of the molten tin as it is drawn over the partial clasps on the soldering iron is liable to pull them off or displace them slightly. After finishing the partial clasp and the spring clasp, the anchorage or "arms" are completed. It is best to begin to unite the

Fig. 361.—Use of pins to hold partial clasps in position while soldering. (Eby.)

number of small parts at this junction, reducing to one unit on each side the five or ten small parts, for it is very important to preserve them accurately as they are liable to be displaced during the advanced steps if not united. The weight of the soldering iron against the lin-

gual ends of the clasp is liable to elevate the bucco-cervical portion where the greatest accuracy is required. To prevent this, pins should be inserted to hold the clasp very securely in place (Fig. 361). The thinnest film of solder possible to make the attachment should be used to keep down the bulk of the appliance (Fig. 362).

The next step is the construction of the "base wires" or "body wires" for the connection of the anchor arms across the palate in the upper end and in the sublingual region of the lower. The body wires are made of 12-gauge for average cases, although the gauge should range from 9 to 14, varying with the age, extent of development required, and the control of bulk. The body wires should be made into a number of different designs, but the best plan to follow is to use the simplest form suited for the needs required. The simplest form of

Fig. 362.—Partial clasps and spring clasps united with solder. (Eby.)

Fig. 363.—Body wire for anterior expansion. (Eby.)

upper body wire is made for premolar and anterior expansion only (Fig. 363). This form is made by bending a piece of wire about six inches long into a U-shape to fit around the dome of the palate at the desired point across the molar region. Care must be taken, in determining the points, to bend the ends forward from the points of contact against the molars. If these angles are too high, they will interfere with the occlusion and impart bulk and bad finish. The measurements should be taken with a thumb-nail grasp, as before described, and should be low enough so that the outer curve of the wire will only touch, or, failing to touch, will approximate closely the linguo-cervical border of the molar.

In all heavy wire bending, special care must be taken to calculate the position of the outer curves, and to do this the wire must be

grasped in the pliers at a point, the diameter of the wire away from the desired point of the bend, so as to make this allowance in the height of the curve. The palatal part of the wire should enter the sides about midway of the lingual surface of the distal teeth engaged in the appliance, and the ends should always extend forward or backward, as the case may be in the different designs, to about mid-

Fig. 364.—Body wire for premolar and molar expansion on one side only. (Eby.)

Fig. 365.—Body wire for expansion of both sides of upper arch. (Eby.)

Fig. 366.—Form of body wire used in premolar and molar expansion. Body wire attached with soft solder. (Eby.)

way of the lingual surface of the tooth at the opposite end of the anchor arms. This will impart a round finish at the ends, which is lost if the end projects beyond the point.

It is absolutely necessary for the side parts of the body wires to extend the full length of the anchor arms to render them rigid. Because the linguo-cervical borders of the molars are higher than the pre-

molars, it will be found that as the side of the body wire extends forward, a space will be formed between the wire and the partial clasp on the premolar. It is in this space that the ends of the anterior extension must be fitted and soldered, and the size of the space may be determined by the number of springs to be used (Fig. 363).

Fig. 364 illustrates the body wire for premolar expansion and molar expansion on one side only. Fig. 365 illustrates a body wire for bicuspid and molar expansion on both sides. These are made by bending the wire into the U-shape on the curve of the palate at the posterior region, and then the forward bends are made to be looped back parallel around the jaws of a round-nosed pliers so that the end will terminate at the molar. Care must be taken to preserve the space at

Fig. 367.—Base wire being bent with Case's bending pliers. (Eby.)

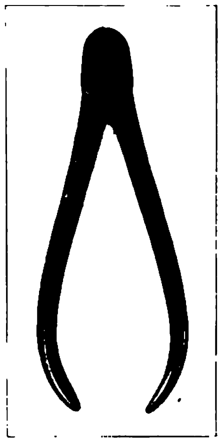

Fig. 368. Case's wire-bending pliers. (Eby.)

the bicuspid region for the anterior springs, and this last loop must not be higher than the cervical zone so the finished appliance will not interfere occlusally.

The form of body wire found to be most effective for the premolar and molar expansion on both sides is shown in Fig. 366. This design contains less material than the one shown in Fig. 365 and responds to lines of lateral development with better effect. In constructing this style of body wires, the wire is first bent into a U-shape to rest in the dome anterio-posteriorly with the ends pointing distally. The ends are then looped over the jaw of the round-nosed pliers and brought forward, observing the same precautions as to position and terminating midway of the lingual surface of the teeth at the anterior

end of the anchor arms. The body wires must not touch the soft tissues at any point. After construction, they may be held to position with moldine, and should be quickly tacked to place with a very light solder on both ends and both sides (Fig. 366). The finer bending of these heavy wires (Fig. 367) can be made to best advantage with the plier designed by Case (Fig. 368). Soldering the body wire to position completes the body and arm portions.

Fig. 369.—Showing construction of finger spring to body wire. (Eby.)

Fig. 370.—Soldering finger spring to body wire. (Eby.)

All extensions and springs from these parts are known as "finger springs" or "fingers." Fingers are made of 18-, 19-, and 20-gauge wire, and are adjusted usually to the surface of the teeth opposite the direction of motion. Fingers vary in design with every individual case.

Careful comparison of a given irregularity with the normal and measurements to determine the extent and direction of the usual movement may show the path of movements towards the normal to be such that the arch may be corrected in segments, and the study of other conditions may show that all the teeth must move on individual paths. The effectiveness of the Jackson method is its great adaptability of design to meet various conditions with equal advantage and facility.

Fig. 369 shows a condition caused by permanent extraction of the left deciduous cuspid, which, by breaking the proximal continuity of the arch, allowed the muscles to narrow the two posterior segments and drift the incisors lingually from the right canine at the center of the rotary axis. The molar expanding body wire is indicated for restoring the two posterior segments to normal width.

One lingual "finger" bent on the normal curve of the lingual surfaces should be attached to the right arm of the appliance. By rendering this finger active with the right canine at the rotary center, the path of movement of each incisor will be determined by the radius of the spring from the central axis of the point of contact at each tooth. The path of movement of the left lateral will be outward and to the right on a greater arc than that of the left central. The path of movement of the left central will be on a greater arc than that of the right central. The path of movement of the right central will be on a greater arc than that of the right lateral. By the pressure of this spring, each incisor will be moved along a different path toward its normal position, restoring normal incisal relations and concentrating the space gained for the left canine.

The appliance is shown in Fig. 370 prepared for the finished soldering on the right side. The finger is held in position with moldine, and the spring clasps repinned into position to prevent them from slipping buccally. Zinc chloride is now applied to the entire side freely. The hot soldering iron is dipped continually in the flux before soldering to keep it well tinned and cleaned. Globules of pure block tin are carried on the iron and flowed well down into the crevices between the clasps and the body wire. Enough solder should be applied to slightly round off the exposed surface, to impart a smooth finish.

Fig. 371 shows the buccal aspect of the left side finished. A buccal

"finger" has been extended to press the canine into alignment after ample space is made for it. This illustration also shows how the spring clasp has been shifted to the second premolar and second molar on this side to prevent the need of two wires crossing the occlusion between the premolar and the canine.

Fig. 372 illustrates the exposed aspect of a soldered appliance ready

Fig. 371.—Finger spring used for depressing canine. (Eby.)

Fig. 372.—Appliance completely soldered. (Eby.)

for removal from the model for the first time for polishing. It also shows the laterals collared with lugs, soldered to the lingual surfaces beneath which the "finger" snaps to be held securely in position. All of the posterior teeth are anchored against the labial movement of the incisors. The incisors and right posterior teeth are anchored against

the left posterior teeth (ten anchor teeth against four teeth to be moved) which have moved lingually more on the right side. The exposed surface of the appliance removed from the model is shown in Fig. 373.

After a sufficient amount of tin is added to the side of the arm, it should be melted along the full length at one time. This will cause it

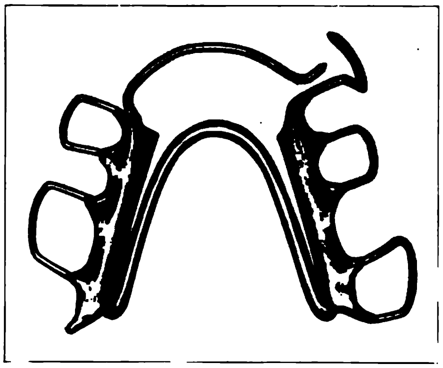

Fig. 373.—Appliance removed from model. (Eby.)

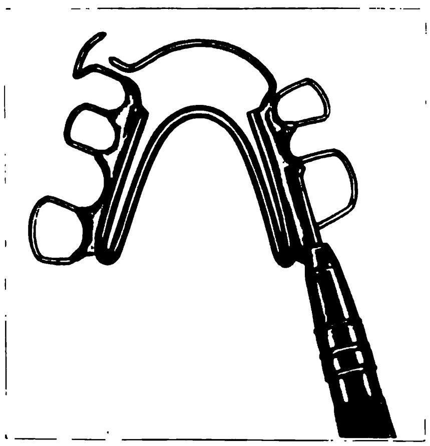

Fig. 374.—Cutting out solder to prevent pressure on gingival gum tissue. (Eby.)

to harden in a uniform smooth surface which requires only a few strokes from a sand paper disc to prepare for the lathe polishing. The lingual side of an appliance requires very little attention in polishing. Sharp projections of the partial clasps extending too far interproximally should be cut away. When the solder runs around the

ends of all the wires, completely enveloping them, it is cast against a strip of plaster representing the outline of the free margins of the gums. If this solder should touch the soft tissues, a slight compression will be established as the appliance settles. This pressure will exclude the circulation from the capillary terminals and will devitalize strips of tissue which will resolve into a dense, white mass. To avoid this, the palatal side of the tin between the cervical border of the partial clasp and the body wire should be cut out to a reasonable depth, forming a smooth, concave surface with a self-cleansing space between the appliance and the gum (Fig. 374). Great care should be taken in this step not to injure the cervical borders of the partial clasps, and they should be left projecting well up above the tin to enter the cervical constriction at the gum border. Fig. 375 illustrates this, showing a cross section cut through the middle of the molar clasp.

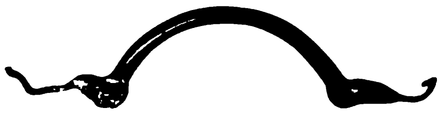

Fig. 375.—Cross section of base wire and partial clasp, showing gingival extensions. (Eby.)

After excluding all sharp points to be found and rounding the ends of the finger springs, appliances are polished with the lathe. A felt wheel should be used and a stiff mixture of pumice to the exposed surface of the tin, which will make the tin very smooth. The lingual portion of the tin should be polished with bristle brush wheels with ample pumice.

After removing all tool scrapings and pumice, a luster can be imparted by washing off the pumice, drying the appliance and reapplying the same brush wheel with which the pumice was used, when the moist bristles and the slight amount of remaining pumice will impart a lasting finish. The final luster can also be made by prepared chalk paste on a camel's-hair wheel.

The construction of the lower removable Jackson appliance is very similar to the construction of the upper appliance. The posterior, side arm anchorages are to be made in the same manner, although all finger extensions are to be governed by the same various respective designs for the given conditions at hand. The body wires for lower appliances cannot vary under different conditions, however, because of the limited position which they occupy between the inner surface of the mandible and the tongue.

After the side arm anchorages are completed, the first step in lower body wire bending is to bend the wire into a U-shape to fit closely around the lingual curves of the anterior segment of the arch with the ends pointing distally. In placing the anterior portion of this heavy wire, it must be so placed that the ends may be bent back upon themselves from points in the region of the most distal teeth engaged in the anchorage, running parallel with the lower portion forward, and terminating about midway of the most anterior anchored teeth engaged with spring clasps.

If a straight loop is placed low enough in the sublingual region, it will interfere with the motion of the frenum linguæ, which will cut into it in a very painful and damaging manner. If a straight loop is

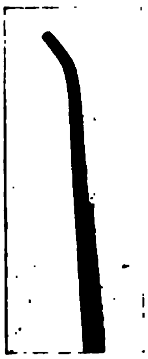

Fig. 376. Anterior end of lower wire bent occlusally. (Eby.)

Fig. 377.—Lingual base wire bent occlusally with heavy pliers. (Eby.)

placed higher than this region, it is very difficult to bend the ends forward and keep the upper portion low enough to solder along the lingual surface of the posterior teeth without touching the lower portion of the wire which it parallels. This renders it very difficult to keep the solder from running between the wires and the adjustment is made more difficult in tightening, if the wires are very close together. In order to compromise between these conditions, it is necessary to bend the anterior end of the wire upward (Fig. 376). The best method of making this bend is to first bend the correct size and shape around the sublingual region, then by grasping the desired amount of the anterior portion between the jaws of the heavy parallel pliers, the bend can be made, retaining uniformly horizontal relations between

the ends which point posteriorly (Fig. 377). That portion which is bent upward can be placed along the most prominent part of the ridge below the gum margin of the anterior teeth, allowing the ends to run backward at positions low enough for the looped parallel ends to fold back and rest no higher than the gingival borders of the posterior teeth with about one-eighth of an inch between them, thus re-

Fig 378.—Position of lingual body wire for lower appliance. (Eby.)

Fig. 379.—Lower body wire with ends bent anteriorly held in place with moldine. (Eby)

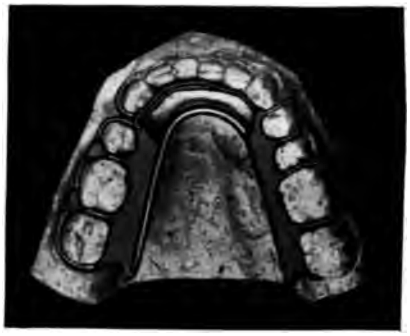

Fig. 380.—Completed lower appliance with finger springs attached. (Eby.)

ducing the bulk, permitting a thin bevel finish and not interfering with the tongue or pressing against the soft tissues (Fig. 378). The final bend should be made around the nose of the "round-nosed" pliers. Fig. 379 illustrates the completed lower body wire suspended in moldine slightly away from the soft tissues. Note that the anterior portion rests higher than the frenum linguæ can reach, but at

the same time low enough so as not to interfere with finger extension adjusted to the lingual surface of the anterior teeth. The body wire should be tacked to position with a very small amount of solder at the posterior ends leaving ample space between the arms and the upper loops of the wire to form a groove into which is soldered the attachment ends of the finger springs.

Fig. 380 illustrates the completed appliance for this case. It will be noted that the continuity of the arch has been broken, shown at present by the absence of the left first bicuspid. The normal diameter of this arch is reduced the amount of the mesio-distal diameter of this missing tooth. Under this condition, the history of the case may reveal the early loss of the deciduous molar with the resultant migration of approximating teeth, causing impaction of the premolars. The environments of the teeth under the influence of the tongue lingually, the buccal and labial muscles, and the occlusal stress, have reduced the size of this arch in certain segments which are normal and regular, insofar as relations between the teeth in these segments are concerned. If this missing tooth has been extracted merely to correct a buccally erupted canine, the same conditions exist from the corrective standpoint on the basis of normal occlusion.

This is a case of neutroclusion, the left molars and second premolars having formed lingually, but they have not moved mesially. The anterior teeth have moved lingually, proportionately greater at the left canine. The left molars and the second premolars are in correct relation in one segment; the anterior teeth are in correct relation in the second segment; and the right posterior teeth are in correct relation in the third segment. The three teeth comprising the left segment are engaged with a full spring clasp on the first molars and two partial spring clasps on the proximal teeth soldered together on the buccal sides.

There is more constriction on the left side than on the right side, indicating the need of a greater resistance for less expansion on the right side; therefore, the four posterior teeth are engaged on the right side with partial plates on the lingual surface, the first premolars bearing a partial clasp, but owing to the fact that the right second molar is not fully erupted, the spring wire is placed on the first molar. The right canine rests as the rotary center around which the anterior teeth have moved lingually.

A finger spring is adapted to the curve of the lingual surfaces and soldered into the right arm of the appliance, terminating at the other end in the form of a hook looped around the distal proximal side of

the left canine. These anterior teeth may be banded for lugs to be soldered to the lingual surfaces for this finger to snap beneath, or a second lingual finger may be adjusted to rest above the lower one for the purpose of holding it securely down to position under active pressure. When this lower spring is rendered active by bending it forward from the right side, each anterior tooth is moved in a different arc toward its normal position. The finger affords the left canine a long radius through which it moves forward and outward toward a straight line across the arch opposite the right canine, to its correct position of angular prominence in the parabolic curve of the normal arch.

The left lateral responds to the path of force applied on a shorter radius than the canine, the left central less than the left lateral, the right central less than the left central, and the right lateral less than the right central, and the right canine is only slightly turned. In this way the fingers may be so controlled as to guide each tooth in a segment of a circle along entirely individual paths of movement toward their normal positions in the dental arch.

By using the posterior loop of the body wire as rotary centers, a uniformly diffused expansion can be accomplished between the molars and premolars. If positive molar expansion is required, the middle of the anterior curve of the body wire is bent open as a rotary center. In this way individual tooth movement can always be perfectly controlled under a type of active anchorage which renders it impossible for unexpected secondary forces to cause warpage of arches of depressions, elongations, or other displacements of any serious nature.

The removable appliance possesses valuable features for the correction of irregularities of the deciduous teeth. The correction of malocclusions usually involves development across the posterior side of the subsequent anterior alignment. The gingival constrictions of deciduous teeth do not afford favorable undercuts for the spring clasp attachment for the simple removable appliance. It is, therefore, often necessary to use the fixed-removable attachment on the deciduous teeth. Even with this method, the technique of fitting simple bands to anterior and posterior anchor teeth on both sides can be very easily and effectively accomplished in the mouths of children between the age of five and seven, after which the bands are removed in a plaster impression and the appliance finished out of the mouth.

In the correction of malocclusions during those intermediate years between the loss of deciduous teeth and the eruption of permanent teeth the removable appliance possesses many valuable features. There

is no more favorable time for the correction of malocclusion than during the period from seven to twelve years of age, or during that period when deciduous teeth are being lost and the permanent teeth are taking their position in the dental apparatus.

Fig. 381 illustrates the lower arch with irregularities caused by the early loss of temporary incisors, which has caused the posterior sides to lose their stimulus and the lateral development has not been sufficient. If the case is allowed to remain in this condition, the permanent lateral incisors will be crowded out of the arch and forced to take positions of malocclusion. This removable appliance possesses full spring clasps for the second premolars with partial clasps on the first premolars soldered to the full spring clasps on the buccal sides. The body wire is made of the 13-gauge wire. Small hook-shaped extensions engage the canines. In these two side arms exists a uniform degree

Fig. 381.—Lower appliance constructed to produce expansion in incisor region. (Eby.)

Fig. 382.—Appliance constructed to exert pressure on central and laterals. (Eby.)

of resistance, so that by the mild but constant stimulus of the spring force from the body wire there is produced the lateral development, restoring the normal width and concentrating the space for the normal eruption of the lateral incisors. If the centrals are spaced, new finger springs may be added at any time with which to draw them together.

Fig. 382 illustrates the removable appliance constructed to exert pressure upon the centrals and laterals which have taken abnormal positions. With this type of appliance the finger springs can be changed any number of times as the treatment progresses.

Fig. 383 illustrates the anchorage engaging the permanent molars with the anterior portion of the appliance designed for the lateral expansion of the arch so as to diffuse the space thus gained through the anterior segments of the arch. After the lateral development is ac-

complished, the anterior extension may be replaced with "fingers" to perfectly align the incisors and in this progressive manner the appliance can never be too complicated to be unnecessarily bulky and the different parts interfere with the work of each other.

A great advantage of the Jackson appliance in cases at this age, as in many others, is the ease with which the appliance can be altered to meet the enlarged dimensions of the growing arch and still have the appliance so constructed as to not interfere with the eruption of teeth, for the appliance occupies a very small space in the oral cavity. The removable appliance possesses decided advantage over some fixed types

Fig. 383.—Appliance with finger springs to distribute space in incisor region. (Eby.)

Fig. 384.—Appliance with labial bow to depress protruding anterior teeth. (Eby.)

because of the fact that it exerts a gradual spring force, and should the pressure be so great at any time as to cause inconvenience to the patient, the nurse or parent can remove the appliance and the child will avoid the inconvenience and soreness of teeth which often accompanies the fixed appliance where too much pressure is used and the patient is unable to remove it. However, to accomplish the greatest results with the removable appliance we must have the coöperation of the patient. This is not so difficult to obtain as would be imagined because of the fact that the appliance is quite inconspicuous, practically painless, and produces very little annoyance.

CHAPTER VII

ANCHORAGE

Anchorage, which may be defined as the resistance used to overcome an applied force, is one of the most important requirements of a regulating appliance. In orthodontia, the applied force is exerted by the regulating appliance upon the teeth that are in malocclusion and in turn there must be a reaction that must be resisted. As action and reaction are equal, the anchorage must be strong enough to withstand this applied force.

Anchorage is first classified according to the source of origin into three groups—intramaxillary, intermaxillary, and extramaxillary.

Intramaxillary anchorage is that form where the resistance necessary to overcome the force required to move the malposed tooth is obtained from a point located in the same arch.

Intermaxillary anchorage is that form where the resistance necessary to overcome the force required to move the malposed tooth is obtained from a point in the opposite arch.

Extramaxillary anchorage is that form where the resistance necessary to overcome the force required to move the malposed tooth is obtained from a point outside the mouth.

Intramaxillary and intermaxillary anchorage may be divided or classified according to the number of teeth used from which the resistance is obtained. If but one tooth is used, it is called single anchorage. If two or more teeth are used as points of resistance, it is termed reënforced or compound anchorage. Intramaxillary and intermaxillary anchorage may also be divided with reference to the manner in which the resistance is obtained: into simple, stationary, and reciprocal.

With these definitions and plans, the following diagram has been constructed to show the various combinations of anchorage:

Of these various anchorages, intramaxillary is probably the oldest variety that we have. According to the literature on the subject, extramaxillary anchorage was the next form to be used; while intermaxillary anchorage as used today belongs to modern orthodontia.

- **Intramaxillary**
  - **Simple**
    - **Single, or primary**
    - **Compound, or reënforced**
  - **Stationary**
    - **Single, or primary**
    - **Compound, or reënforced**
  - **Reciprocal**
    - **Simple primary**
    - **Simple compound**
    - **Stationary primary**
    - **Stationary compound**
- **Intermaxillary**
  - **Simple**
    - **Single, or primary**
    - **Compound, or reënforced**
  - **Stationary**
    - **Compound**
  - **Reciprocal**
    - **Simple primary**
    - **Simple compound**
    - **Stationary compound**
- **Extramaxillary**
  - **Occipital**
  - **Facial**
  - **Cervical**

Intramaxillary Anchorage.—Intramaxillary anchorage is that form of anchorage in which the resistance necessary to overcome the malposed tooth or teeth is derived from a tooth or teeth located in the same arch.

Intramaxillary anchorage is divided into simple, stationary, and reciprocal.

Simple Intramaxillary Anchorage is subdivided into primary, or single, and reënforced, or compound, and reciprocal intramaxillary anchorage into primary and compound. Stationary intramaxillary anchorage may be divided in the same manner.

Simple Primary, or Single, Intramaxillary Anchorage is that form in which the resistance necessary to overcome the malposed tooth is derived from a larger tooth or one more favorably located. Fig. 385 shows a lateral incisor that has force exerted upon it by means of an appliance attached by primary, or single, simple intramaxillary anchorage. The molar, being the largest tooth and more favorably located, overcomes the force necessary to produce movement of the incisor. No other teeth are employed to overcome the force, nor is the appliance so constructed as to aid the anchor tooth.

Reënforced, or Compound, Simple Intramaxillary Anchorage is that form in which the force necessary to produce movement of the malposed teeth is overcome by two or more teeth, larger or more favorably located. Fig. 386 shows where attachment is made to the molars and premolars to move the premolar on the opposite side.*

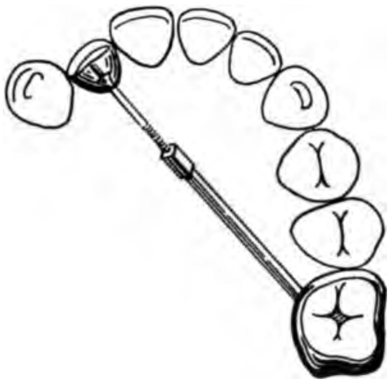

Fig. 385.—Plain bands on lateral and molar teeth with jack-screw, showing simple primary intramaxillary anchorage.

In simple anchorage, either primary or reënforced, if sufficient force is brought to bear upon the anchor tooth it will tip as the attachment is made in a hinge manner. If a rubber band is stretched over two separated teeth with the object in view of drawing one toward the other, we would have simple anchorage, provided that one tooth is larger and more favorably located. In simple anchorage one of the teeth is generally in normal occlusion and the other in malocclusion, for it is intended to hold the anchor tooth still and move the malposed tooth. Sometimes simple anchorage is secured from the molars that are in normal mesio-distal relation with the idea of moving the anterior teeth mesially, in which case

*Reënforced simple intramaxillary anchorage is also called compound simple intramaxillary anchorage.

the molars are not disturbed mesio-distally; yet another force may be exerted to move them buccally. The force that moves them buccally does not prevent them from being used as simple anchorage in providing a point from which force is exerted upon the incisors. Therefore several forces may be active on the anchor teeth at one time.

One of the disadvantages of simple anchorage is that the appliance cannot be assembled or constructed so as to increase the stability of the anchor tooth. Care must be exercised not to place too much force on the anchor tooth or it will be displaced, much to the chagrin of the operator. The great number of cases in which the anchor tooth was displaced, made

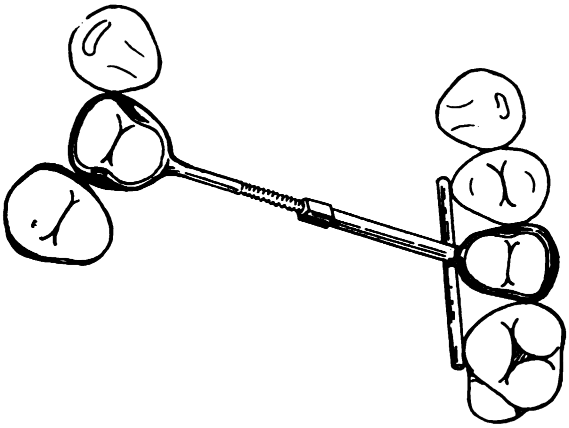

Fig. 386.—Reënforced simple intramaxillary anchorage. Plain bands on premolar with bar on right premolar band to reënforce it.

it necessary to devise some form of attachment that would be more rigid and fixed. So after many attempts stationary anchorage was evolved and described by Angle.

STATIONARY ANCHORAGE is that form in which the appliance is so constructed and attached to the anchor tooth that if the anchor tooth moves at all, it will move bodily through the process. It has been stated that with the use of simple anchorage there is danger of moving the anchor tooth. There is not one tooth in the mouth that is entirely immovable, as the spring of the alveolar process and the peridental membrane allows the teeth to be moved; so it is logical to expect that a tooth will often move slightly when used as an anchor tooth. If this movement occurs in simple anchorage it is a tipping movement, but in stationary anchorage the "appliance is so attached to the anchor tooth" that a tipping movement is impossible. Not only must the appliance be attached to the anchor tooth in such a manner as to eliminate any "hinge" movement, but

all parts of the appliance must be so constructed as to prevent any tipping or springing between the parts. As the early regulating appliances were some form of a jack-screw for pushing or a traction screw for pulling, the problems of simple and stationary anchorage were worked out with these appliances. Therefore they are figured in the illustrations accompanying this text although they are only occasionally used now. Stationary anchorage was developed and perfected as a matter of necessity, for it dates back to the time when extraction played a large part in the regulation of teeth. In Class II, Division 1 cases (distoclusion cases with protruding upper incisors), it was at one time the approved treatment to extract the upper first premolar and to move the canine and incisors distally. Great force was required to move the canine distally and with simple anchorage the molar was displaced. Even reënforced simple an-

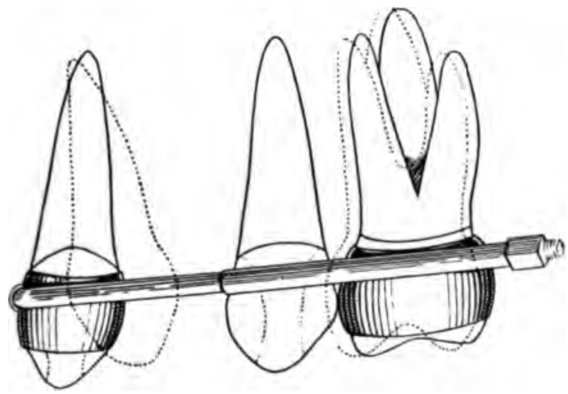

Fig. 387.—Showing plain band on canine and clamp band on molar. **The long tube on molar band prevents molar from tipping, hence if it moves it must move bodily, as shown by the dotted outline.** The canine will tip.

chorage was not sufficient to provide enough resistance to overcome the force necessary to "move" the malposed teeth.

In order to have stationary anchorage, there are two things that must be secured, viz., rigidity and stability of the appliance. The appliance must be made from some material that will not bend under the necessary force, and the parts must be accurately fixed together and attached to the tooth in such a manner as to prohibit any movement between the tooth and the appliance. A molar band is placed on the anchor tooth to which the appliance is rigidly attached. These are the things that make stationary anchorage. Fig. 387 shows the manner in which the traction screw is used with stationary anchorage. The long tube that is soldered to the molar band in which the traction screw fits accurately,

prevents any tipping of the parts. The right-angle end of the screw is attached to the canine by engaging the tube, which is placed so as to make a hinge joint when the force is placed on the canine. In order for the molar to tip, the canine end of the appliance would have to move gingivally, which could not occur unless the canine is depressed in the alveolus.

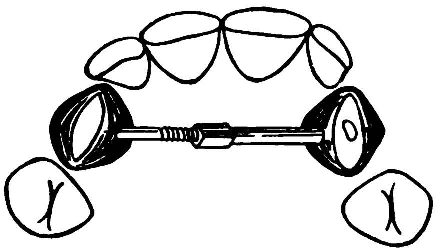

Fig. 388. Primary reciprocal intramaxillary anchorage.

Fig. 387 shows *single stationary intramaxillary anchorage.* If a band was placed also on the premolar and the tube of the traction screw was soldered to the premolar band and the molar band, we would then have *compound stationary intramaxillary anchorage.*

Reciprocal Anchorage is that form in which the force necessary to move a malposed tooth is derived from another malposed tooth, with the

Fig. 389.—Another form of primary reciprocal anchorage. The centrals will be the teeth to move.

idea that both be made to assume a proper position in the line of occlusion. Fig. 388 shows two canines in lingual occlusion. A jack-screw placed between them would exert pressure in such a manner as to move both of them buccally. One of the canines may move more easily than the other, in which case some other means must be employed to increase the resistance of the easily moving tooth. These things will be mentioned

later. A rubber band placed around the central incisors that are separated gives us reciprocal anchorage. Reciprocal anchorage is divided into primary, or single, and compound. It may also be divided into simple and stationary.

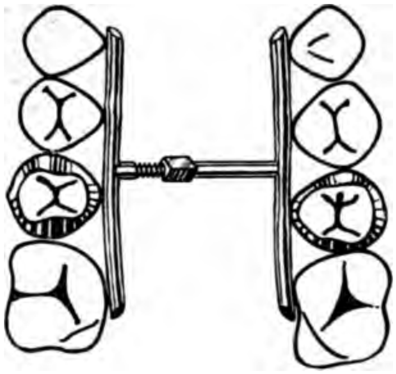

Fig. 390.—Compound reciprocal intramaxillary anchorage.

Fig. 391.—The use of the expansion arch generally embodies compound reciprocal intramaxillary anchorage.

Primary, or Single, Reciprocal Intramaxillary Anchorage is that form in which the appliance is attached to but one malposed tooth on each side with the object in view of moving only those teeth to which the appliance is attached (Fig. 388). A wire passed around the teeth, as shown in Fig. 389, is primary or single, reciprocal anchorage.

Compound Reciprocal Intramaxillary Anchorage is that form in which the appliance is so constructed that other teeth are moved besides the one to which the appliance is attached. Fig. 390 shows a jack-screw attached to a band on the second premolar with a lingual bar soldered to the band

Fig. 392.

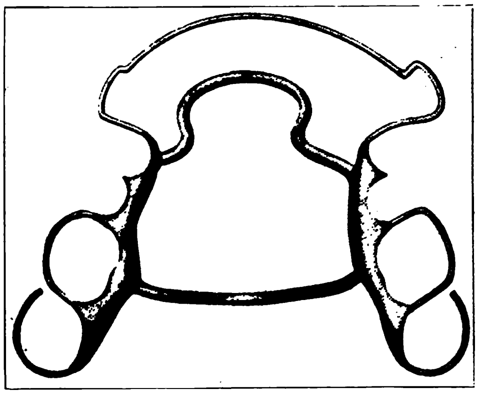

Fig. 393.

Figs. 392 **and** 393.—Removable appliances employing compound reciprocal intramaxillary anchorage.

resting against the molar, premolar and canine, which will move the teeth on each side buccally. The appliance used is exactly the same as shown in Fig. 388, yet several teeth are being moved when only two were moved with primary, or single, reciprocal intramaxillary anchor-

age. The author has used the same appliance in most of the anchorages described to show that anchorage does not depend upon certain appliances. Different appliances can be constructed and used with these anchorages to meet the requirements of the cases.

Fig. 394.

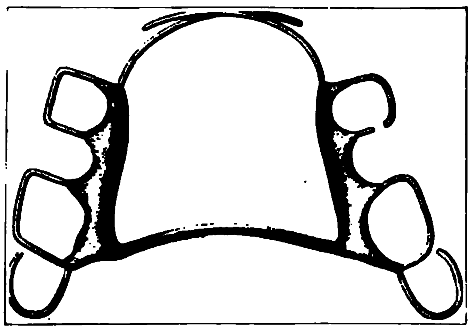

Fig. 395.

Figs. 394 and 395. Removable appliance employing compound reciprocal intramaxillary anchorage.

Compound reciprocal intramaxillary anchorage is the form employed when the expansion arch is used, as shown in Fig. 391. It is also the anchorage employed in the use of the regulating appliance shown in Figs. 392, 393, 394, and 395. In fact, it is used in nearly all cases of malocclusion. To be exact, the use of the expansion arch as shown in Fig. 391 evolves simple compound reciprocal intramaxillary anchorage.

Reciprocal anchorage is further divided into simple reciprocal and stationary reciprocal.

Simple Reciprocal Intramaxillary Anchorage, either primary or compound, is where the attachment is made to the anchor tooth or teeth in such a manner that the teeth can tip. Fig. 396 shows an expansion arch or spring attached to two canines with the object in view of moving them buccally. The tubes are so placed that the teeth will tip because there is a hinge motion possible between the arch and the tube on the band.

Stationary Reciprocal Intramaxillary Anchorage, either primary or compound, is that form in which the appliance is attached to the anchor teeth in such a manner that they will be moved bodily through the process. Figs. 397 and 398 illustrate the same small expansion arch as shown in Fig. 396, which is again attached to two canines, but the tube is so

Fig. 396.—Simple reciprocal intramaxillary anchorage that allows anchor teeth to tip.

placed on the bands and the end of the arch bent in such a way that the canines are moved bodily. In cases where the molars are to be moved bodily, an arch with a square end and a tube that is square on the inside make stationary reciprocal anchorage on the molars with the expansion arch (Fig. 399).

The use of the ordinary expansion arch with round ends and the wire ligatures embodies simple compound reciprocal intramaxillary anchorage. This is the most generally used form of anchorage.

Intermaxillary Anchorage.—Intermaxillary anchorage has been defined as that form in which the resistance necessary to overcome the malposed tooth or teeth is derived from a tooth or teeth located in the oppo-

site arch. In other words, the malposed tooth and the anchorage are in different arches. Intermaxillary anchorage is the newest form that we have and has done more to eliminate the extraction of teeth than any other. It offers many combinations and is the least understood of any of the anchorages by the majority of practitioners.

Fig. 397.

Fig. 398.

Figs. 397 and 398.- Stationary reciprocal intramaxillary anchorage. Anchor teeth must move bodily.

In regard to the number of teeth moved, intermaxillary anchorage is divided into primary and compound, and in regard to the manner of movement, into simple, stationary and reciprocal.

Primary Simple Intermaxillary Anchorage is employed when a tooth

in one arch is used to overcome the force necessary to move a tooth in the opposite arch. It is employed in moving teeth that are in infra-occlusion. An example is shown in Fig. 400, where the canine is in infra-occlusion and the anchorage is obtained from the lower premolar.

Compound Simple Intermaxillary Anchorage is that form in which one or more teeth in one arch are moved by force derived from teeth in the opposite arch. This is shown in Fig. 401, in which case the central incisor is in infra-occlusion and the force in derived from the lower teeth.

Primary Reciprocal Intermaxillary Anchorage is that form in which

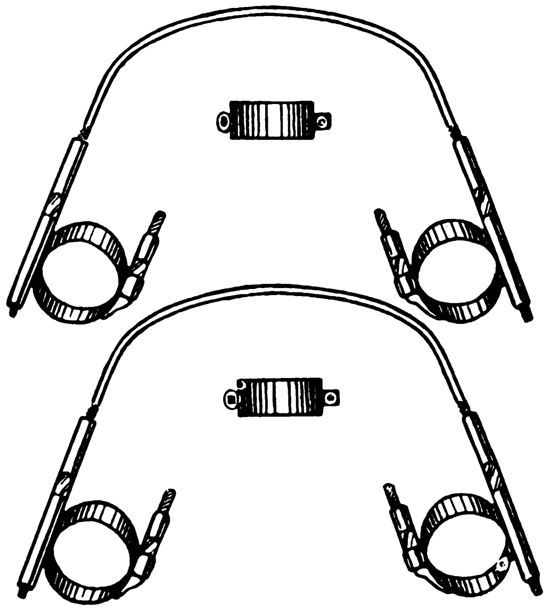

Fig. 399.—The square tube and arch used on molars make stationary anchorage on the molars. Oval buccal tube shown above, square buccal tube below.

the force necessary to move a malposed tooth in one arch is derived from a malposed tooth in the opposite arch, the force causing both to assume a proper position in the line of occlusion. An upper and lower canine that are in infra-occlusion, as shown in Fig. 402, is an example of this anchorage. Such cases as illustrated here are seldom seen, as there is generally some other malocclusion present demanding treatment at the same time.

Compound Reciprocal Intermaxillary Anchorage is that form in which two or more malposed teeth of one arch are pitted against two or more teeth in the opposite arch for the purpose of causing both to assume a

-lusion. This form of anchorage could
-th of the upper and lower arch are in
Fig. 403. However, it is very seldom
at demand an equal movement of the
The most frequent use of compound
age is in the treatment of Class II, or
esioclusion cases, and according to the
is was the manner in which it was em-
been used in this way by Baker and
by Angle. When all of the teeth in one

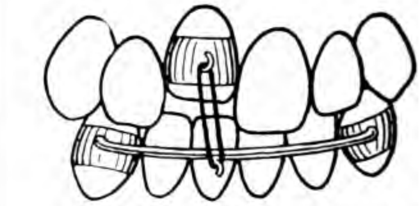

Fig. 404. Compound simple intermaxillary anchorage.

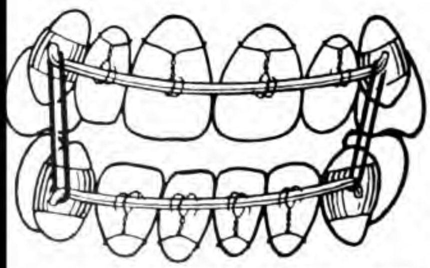

Fig. 405. Compound reciprocal intermaxillary anchorage.

teeth in the opposing arch, with the ob-
in both arches, this form of anchorage
own in Figs. 404 and 405. It is possible
maxillary anchorage by pitting a certain
against a certain number of teeth in
of mouth that the same kind of teeth in
ame kind of teeth in the other. In Fig.
was necessary to move the superior in-
emolars, canines and incisors mesially.
compound reciprocal intermaxillary

Fig. 404.

Fig. 405.

Figs. 404 and 405.—Compound reciprocal intermaxillary anchorage used with expansion arches.

hich is described in Chapter XI. This e should also be called simple, the teeth as to permit tipping.

chorage is that form in which the at- teeth in one arch in such a manner that dragged bodily through the process, the th being in different arches. This form tructing and applying the appliance in ing impossible and is the outgrowth of rmaxillary anchorage. It was found in

reciprocal intermaxillary anchorage.

at the mandibular teeth moved forward teeth moved distally. In order to stop teeth it becomes necessary to make them he proper construction and attachment ncreased the movement of the maxillary th remained immovable. If bands are ndibular molars and the arches applied shown in Fig. 404, we would have com- anchorage of the simple form. This t a type of the maxillary and man- t simple anchorage. As stated before,

the maxillary teeth would not move as rapidly as the mandibular and by bending the anterior part of the lower arch gingivally, also placing wires around the anterior mandibular teeth, which would spring the arch upward to its proper position, a backward force would be exerted upon the mandibular molar that would overcome the forward pull of the intermaxillary rubbers. The tipping stress exerted upon the mandibular molars by the bent arch and the wires on the lower anterior teeth springing the anterior portion upward, converts the anchorage into a stationary one on the lower teeth. The maxillary teeth can still tip. The manner of bending the arch and wiring it is shown in Fig. 407.

As soon as the lower appliance is adjusted, as shown in Fig. 407, the anchorage is no longer reciprocal as the mandibular molars stop tipping. By making the attachment on the lower arch, as shown in Fig. 694, the lower anterior teeth are also prevented from tipping and must move bodily. This forms stationary attachment to the lower teeth.

Fig. 407.—Showing manner of bending lower arch gingivally and then springing occlusally to make lower molars stationary. Dotted line indicates position that lower arch will occupy when sprung occlusally.

It is very seldom that the teeth of both arches are moved bodily to the same extent. What generally occurs is that the teeth of one arch are made rigid by the attachment of the appliance so as to prevent movement and the teeth of the other arch are so attached to the appliance that they will move bodily. This would then be only another form of compound stationary intermaxillary anchorage. An example of the stationary attachment of teeth in both arches is seen in Fig. 325, which is a Class II, Division 1 (distoclusion, with labioversion of the upper anterior teeth) case. It has been found that the best results in these cases are obtained by not moving the mandibular molars and canines distally, and moving the entire lower arch or teeth mesially the entire

distance necessary to establish normal occlusion. Also, the best facial results and masticating apparatus are obtained by moving the lower teeth bodily. Bands are placed on the mandibular and maxillary molars. The upper arch is ligated to all of the maxillary teeth in such a manner as to

Fig. 408.—Occipital extramaxillary anchorage. (Angle.)

Fig. 409.—Occipital extramaxillary anchorage. (Angle.)

prevent the maxillary molars from tipping. If the anterior portion of the upper expansion arch cannot move occlusally, the molars cannot tip. The lower expansion arch is also wired to the mandibular teeth so as to prevent tipping of the molars; to prevent tipping of the incisors, spurs are placed on the lower arch and the incisors wired to them in such a manner as to hold the teeth perpendicular with the spurs, as shown in Fig. 706. The advantage of stationary compound intermaxillary anchorage whether used reciprocally or not is very great and is the last form of intermaxillary anchorage to be introduced.

Fig. 410.—Cervical anchorage. (Carl Case.)

Extramaxillary Anchorage.—Extramaxillary anchorage is that form in which the resistance necessary to overcome the malposed tooth or teeth is derived from some source outside the oral cavity. It offers the most immovable base that can be obtained. The principal objection is the appearance of the appliance. There are three types of extramaxillary anchorage—occipital, facial and cervical.

Occipital Anchorage is where the force necessary to overcome the malposed tooth is derived from the occipital region. This is one of the oldest forms of anchorage of which we have a record. It was first used with an ordinary night-cap and was improved and modified by various means until we find the most ideal form as designed by Angle. (See Figs. 408 and 409.)

Facial Anchorage is where force necessary to overcome the malposed teeth is derived from the facial bones. This anchorage was introduced

by V. E. Barnes and consists of a device which rests against the molar bones and forehead.

Cervical Anchorage was introduced and first applied, to the author's knowledge, by Carl Case (Fig. 410), and is that form in which the force necessary to overcome the malposed teeth is derived from the cervical vertebræ (Fig. 410). Occipital anchorage was used in those cases that demanded a distal movement of the anterior teeth. It was used on the superior anterior teeth, as shown by Fig. 408, and by means of the chin cap (Fig. 409) the pressure was exerted on the mandible. It was also used to exert pressure on the mandibular anterior teeth, but there was a tendency to elongate the mandibular anterior teeth. It was to overcome this tendency to elongate the mandibular anterior teeth that cervical anchorage was devised. Facial anchorage was devised to move the teeth mesially, and is valuable in those cases that demand the forward movement of the upper and lower molars. If one is able to use the various other anchorages as they should be used, there is little need for extramaxillary anchorage.

Owing to the fact that reciprocal anchorage utilizes all of the force exerted on the malposed teeth, it is the most useful form of anchorage. With intermaxillary anchorage in the various compound, reciprocal, and stationary forms, we are able to get tooth movement in any particular direction desired. Simple anchorage is the easiest to obtain but not always sufficient for the needs of the case. Stationary anchorage requires a greater understanding of mechanics than any other form. The principal and most useful forms of anchorage will be considered in the chapter on treatment of cases.

CHAPTER VIII

RETENTION OF TEETH

It has been said that the problem of modern orthodontia is one of retention. With the modern regulating appliances it becomes quite easy to regulate teeth, but to keep them in their new position has been difficult.

Forces of Retention

Retention is the application of force to maintain teeth in their proper position in the line of occlusion. Not only must the teeth be retained in position in the line of occlusion, but they must often have force exerted upon them to assist them in assuming different angles and lengths than are present immediately after the regulating appliance is removed. It has been said that retention is the application of force to maintain and produce normal occlusion. It must be remembered that teeth are not held rigid in the dental apparatus but are constantly moving under the stress of mastication; also that they are held in position by the forces of occlusion and are constantly changing positions during the growth of the individual. Therefore the force exerted upon the teeth during retention must be exerted with that idea in view.

The forces of retention are mechanical and natural.

Mechanical Forces

Mechanical forces are those that are exerted by artificial devices. They exert force until the natural forces can establish themselves, for it must be remembered that all cases of malocclusion are the result of interference with some of the forces of occlusion. In other words, some one of the natural forces of retention has not been active.

Mechanical forces are divided into active and passive.

Passive Mechanical Forces are those that antagonize the backward tendency of the teeth only, and do not exert any force, simply resisting the efforts of the teeth to return to their former position. Angle has said that teeth should be retained against their backward tendency only. This backward tendency of the teeth can be prevented by the use of passive force.

Active Mechanical Force is obtained by the use of an appliance that

and a constant force is being exerted by
to that exerted by the backward tendency
of such a force enables us to use a more
chance to regulate the force exerted upon
h to move under the stress of mastication,
sume normal positions more readily, by
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passive.

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e teeth is derived from some source out-
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Taking the forces more in the order given above than in their order of importance, for it is hard to say which is the most important, we will begin with one with which all are familiar, viz., the "Normal relation of the inclined plane."

Force of the Inclined Plane.—Since so much has been written on this as a force of occlusion, it will be unnecessary here to go into details. However, the author wishes to caution the reader again that the lingual cusps are as important as are the buccal cusps. We must keep in mind the various shapes of the teeth, especially the lower premolars; also the position that they occupy in the arch.

Fig. 411 shows the different shapes of the mandibular second premolars. They are illustrations made from a skull and model in the author's possession. The lower second premolar with three cusps is not so rare as might be supposed and each cusp has a definite occlusion.

Fig. 411.—Different shapes of mandibular premolars, which must be considered in retention.

We must also take into consideration the fact that the lower premolars do not occupy the same angle of inclination as do the upper premolars (Fig. 412). A line drawn through the buccal and lingual cusps of the upper premolars would not be parallel to one passing through the lower premolars. The line from the lower premolars would cross with the apex of the angle to the lingual of the teeth. It is the author's opinion that in a great many cases, the lingual cusp of the lower first premolar has been moved too far mesially in the attempt to get it parallel with the upper. This change has invited the distal surface of the lower canine to turn buccally. These things we must watch, for the influence of the inclined planes in holding the teeth is well understood. We can even determine at the beginning of the case by observing the length of the cusps whether we will have any difficulty whatso-

ever in getting the natural forces of occlusion to assert themselves. Also, in speaking of the length of the cusps in relation to the forces of the inclined planes as a factor in retention, we should not forget the importance of the length of the cusps. In order that we may not have undue trouble in getting the teeth to remain where we desire them, and in order that the forces of the inclined planes be exercised to their fullest capacity, we must be sure that the length of the overbite be no greater than the length of the buccal cusps of the molars and premolars. In other words, when the anterior teeth are edge to edge, the tips of the buccal cusps should just touch. By studying a great many models, we shall find when the cases are retained that we do not always have that condition, and in those cases in which it does occur, experience will prove that they are the ones in which we have our best results; they are the ones from which we have been able to remove the retaining appliance early. If the length of the overbite is not the same as the length of the buccal cusps of the molars and premolars,

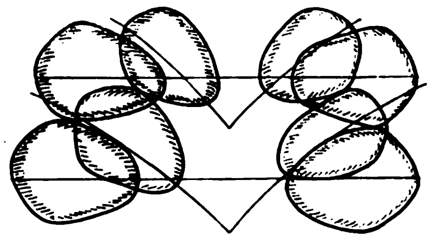


Fig. 412.—Showing the different angles that the lower and upper premolars occupy in the arch.

we must so adjust the retaining appliance that the teeth will be forced to assume the normal position. Great care must be exercised in making the retaining appliance so as to assist and permit the overbite of the teeth to become normal. In this class of cases, the importance of the active mechanical retaining appliance becomes apparent. The force of the inclined plane with reference to the overbite and as a factor in retention, will be again taken up in conjunction with the approximal contact point.

Harmony in the Size of the Arches.—In speaking of harmony in the size of the arches in retention, very little need be said, for if the reader is familiar with normal occlusion, he should understand the importance of this force of retention. However, in order that the reader may better appreciate this condition, the author will call attention to several cases in which this one factor has been neglected. It is true that harmony in the size of the arches cannot be disturbed without throw-

ɔut some other force to a certain extent. The importance of keep-
the proper mesio-distal relation of the teeth in all cases, in order

Fig. 413.

Fig. 414.

413 and 414.—Inharmony in size of arches produced by extraction, making the establishment of normal occlusion impossible, also interfering with retention.

that we may have the proper size of each arch, is as important in the deciduous as in the permanent teeth. The evils of extraction are so apparent that it is hardly necessary to mention them. Aside from destroying the facial contour and expression of the patient, extraction renders the establishment of normal occlusion impossible, because it forever destroys the possibility of again having harmony in the size of the arches. Owing to the fact that no two teeth in both arches are exactly the same size, the arches would not be of equal size should any of the teeth be extracted. Therefore, when in a "fit of wisdom" some one takes out different teeth in opposite arches, normal occlusion becomes a thing impossible for that patient without artificial substitutes. The case shown in Figs. 413 and 414 is one of this kind. Fig. 415 shows

Fig. 415.—Inharmony of arches produced by the prolonged retention of mandibular second premolar.

a case with a lower second molar retained too long. An x-ray showed that the premolar is absent. The normal relation of the teeth can be seen in the models, but the molars did not remain as shown. Because the mandibular molar was held distally at the time of the eruption of the maxillary second molar, the first molar was carried forward as it should have been and now the mandibular is distal to normal, not because there was not proper locking of the molar cusps, but because of the inharmony in the size of the arches. In the latter case, regardless of how long mechanical retention would be employed, normal occlusion of all of the teeth could not be maintained when the retainer

was removed, because of the missing natural force of retention. This brings us to the important fact that all fillings and artificial substitutes should have the proper mesio-distal diameter as well as the proper inclined plane and normal approximal contact. In fact, if one force is missing, some of the others will soon be thrown out of balance.

Normal Muscular Pressure.—The importance of normal muscular pressure is well shown in any case in which the patient is a mouth-breather. Of course, some of the deformity that we see in those cases is the result of abnormal atmospheric pressure. Nevertheless we must have the harmonious action of the lips and tongue in order that normal occlusion may be maintained. The great amount of deformity that we find in cleft palates is the result of the muscular pressure that has no constraining influence. Likewise, in abnormal frenums, we see the effect of abnormal muscular action caused by the abnormal attachment of the frenum. We also find cases of large tongues that produce malocclusions. These cases must be treated with the object in view of getting the teeth in such a position that when they are retained the muscular pressure will be normal. Cases that are the result of tongue and lip habits are very difficult to retain because these habits destroy the normal muscular relations.

The importance of the action of the various muscles as a factor in producing and maintaining the proper relation of the teeth has long been a recognized fact. It is one that has also been improperly understood. It should be remembered that we have but four pair of muscles of mastication. They are all attached in the region of the ramus, that is, they are inserted into some portion of the ramus or angle; none of them are inserted forward into the body of the bone. Therefore, all of the force that they exert on the body of the mandible must be transmitted through the teeth during mastication. If we have malocclusion, we shall not find the proper development of the body of the mandible because of the improper stimulation as a result of the improper muscular force. This is especially true in Class II and III cases.

The muscles of expression play an important part in maintaining occlusion and their action is almost entirely confined to the eight anterior teeth. This is easily understood when we consider that all of the muscles of expression, except the levator menti, are inserted into the orbicularis oris; therefore, the result of their action would be apparent at the point of insertion or in the region of the anterior teeth. All of the muscles of expression acting normally will maintain normal occlusion while any of them acting abnormally will produce malocclusion. When we consider that it is necessary to have the sum total of

the muscles of expression, levators and depressors of the mandible, in order to maintain normal occlusion, and that any group of any muscle acting abnormally will produce malocclusion, we readily see what a large part muscular action plays in retention.

Normal Approximal Contact.—The force of the approximal contact differs from the force of the inclined plane in several respects. First, the inclined plane of the tooth acts on the occluding incline of the tooth in the opposite arch, while the approximal contact acts on the adjoining tooth in the same arch; also, the inclined plane is an active force while the approximal contact is a passive force; that is, we see the result or the lack of it through other forces. For example, we may consider the blocks of stone in a masonic arch; as long as they are in their proper place the passive force that they exert to hold up the structure above them is great. If one of them be removed or displaced the entire arch will collapse because of the absence of the force exerted by the approximal contact. A simpler example would be the staves of a barrel. Here the pressure of the staves is balanced by the force of the hoops. Both are passive, yet if one stave is removed or broken the entire barrel will fall to pieces. The hoops and staves of a barrel occupy very much the same relation to each other that the approximal contact of the teeth and the muscular pressure bear to normal occlusion.

The example that the author has cited above, in trying to show what is meant in regard to the passive force of the approximal contact of the teeth, may be further shown with billiard balls, or any spheres of the same size. As the approximal contact of the teeth is but a point, the example of the sphere may be better. If you take three spheres and have them touching each other, lying in a straight line, you will be able to apply great pressure from the opposite sides of them providing this pressure is also in a straight line; the spheres will occupy the same relative position and will not move. However, if you deflect the line of the application of your force but slightly, one or all of the spheres will be moved from the position. Likewise, if the teeth are so arranged in the dental arch that the approximal contact points are normal, each tooth will remain in its proper position and the proper shape of the arch will be maintained. All of the active forces that are brought to bear on the teeth and arches will be resisted by the passive force of the approximal contact points of the various teeth. Many cases have resulted in failure when all other things were as nealy normal as was possible under the circumstances. A position that needs watching is that of the canines, especially the mandibular for if they

are not placed so that the approximal contact is correct, we shall soon find them slipping out of place and the entire arch collapsing, as a result of which the normal occlusion will soon be destroyed. As may be imagined, those teeth that are not well supported by the inclined planes require a greater amount of watching than do the premolar or molar series. This brings us to the fact that there is a definite relation existing between the inclined planes and the width of the approximal contact.

Normal Cell Metabolism.—If the cell metabolism is normal, we shall have the proper development of the peridental membrane and alveolar process. It is evident that the teeth are supported by the above named structures and in the majority of cases the alveolar process develops to support the teeth accordingly as the forces are applied. Of course, the peridental membrane is that "membrane which covers the root of the tooth occlusally to the enamel, the fibers of which pass from the cementum into the connective tissue supporting the epithelium, into the fibrous mass of gum, into the periosteum, into the cementum of the adjoining tooth, and into the alveolar wall." This shows that the peridental membrane not only supports the tooth but also supports the soft tissue around the tooth and some of its cellular elements form the bone of the alveolar wall. This places the peridental membrane and the cells as the prime factors that have to do with the permanent retention of the tooth. If all of the other forces are normal the peridental membrane cells will do their part and a normal alveolus will result and the tooth will be permanently retained. Unfortunately we often find conditions that arise and make the end we wish to obtain impossible—sometimes the result of conditions that we cannot govern and at other times the result of our carelessness. Factors that we cannot control are those that arise in cases of lowered vitality, especially rickets, which disturb the normal cell metabolism. In such cases, the bone formed will be of such faulty structure that the teeth will not remain where placed. Those that we can govern are those that arise when we tamper with some of the forces mentioned, or when we so construct our retaining appliance that the natural forces cannot do their work. One of the most common mistakes is to make an appliance so that the teeth will be held rigid; one that will support the teeth in every direction and not allow any of the force of mastication to fall on the teeth; constructing mechanical retainers so as to interfere with the proper approximal contact of the teeth; or holding the teeth so that the influence of the inclined planes becomes inactive. In order that the peridental membrane may perform its proper function, in

order that the osteoblasts may deposit and build bone as they should, it is necessary for the teeth to be used as they should. In other words the proper force must be brought to bear on the teeth at all times.

Normal Atmospheric Pressure.—Another force that is difficult to classify, yet one that must be taken into consideration in the retention of teeth, is the force of the atmosphere in respiration and deglutition. The air as it passes through the nasal cavity, filling all of the sinuses as it does, exerts a wonderful pressure in the course of a year. The pressure may be slight with each breath, but when this force is added or subtracted, during the growing period of the child's life a great difference will be noted. Also, with each act of swallowing we have the pressure of the tongue and lips plus the pressure of the air as a factor that plays an important part in the retention of teeth. In order to get the advantage of the forces we must be sure that we have a normal nasal tract as well as a normal occlusion. Retention will be a failure unless the child is receiving its supply of oxygen in the proper manner.

Summary of Forces of Retention

In summing up these forces of retention, the author wishes to impress upon the readers their importance as grouped together in certain cases. Beginning with the last one, normal atmospheric pressure, we find that it is very closely associated with normal muscular pressure—so closely that if one is faulty the other is sure to be. If the nasal tracts are closed or not properly developed, abnormal muscular pressure will result, caused by abnormal breathing. In case of enlarged tonsils, we see the evil effect of long enforced voluntary muscular action, as the child endeavors to relieve the pressure and render breathing freer. It would be useless to expect retention to be a success as long as this abnormal pressure of the muscles and forced mouth-breathing are continued. No matter how long mechanical retention is employed, failure would be the final result.

As the cells of the peridental membrane respond to any force that is brought to bear upon the teeth, it is evident that any of the forces of occlusion that are wrong will also exert some evil influence upon the cellular elements, and the development of the tissue will be faulty.

Attention has already been called to the length of the overbite as compared with the length of the buccal cusps, of the molars and premolars. In the normal denture, the length of the overbite should be the same as the length of the buccal cusps. This is the condition as found in the teeth before abrasion and wear have taken place. As man

advances in age, and as the teeth are worn down, we find that the wear of the molars and premolars corresponds with that of the anterior teeth. This permits the "end-to-end" bite as described by A. H. Thompson. It also accounts for the mistakes made by some who thought, because they found this end-to-end bite, that we had no normal occlusion. The author has shown that the teeth are retained by the inclined plane and the harmony in the size of the arches. As the cusp and the overbite are worn off, it is plain to all that the force exerted by the inclined plane becomes less and less. The harmony in the size of the arches is maintained and the approximal contact becomes more important. In fact, as the influence of the inclined plane is lost, the approximal contact becomes more important until it is exerting more force in maintaining normal occlusion than the inclined plane exerts. It would then be safe to say that the teeth are guided and held in place in early life by the inclined plane. When the dental apparatus becomes complete, the approximal contact becomes an important factor and as the force of the inclined plane is lost, it (approximal contact) becomes the greatest force that holds the teeth where they belong.

As the length of the cusp decreases the width of the approximal contact increases. This change can be followed in the study of the human denture and in the study of evolution. In a well-formed dental apparatus—one which has not been long used—we find that the approximal contact is but a point; also that it is some distance from the occlusal surface of the teeth. As the cusps and cutting edge of the teeth are worn off, the occlusal surface becomes near the approximal contact point until finally the contact point is close to, and later at, the occlusal surface. After the teeth become worn off to a greater extent, the contact point is reached; it is worn down and a greater surface of the teeth is in contact than was the case early in life. Instead of having but a point in contact, we have a surface. When the teeth have been in a position of malocclusion for some time, the approximal contact point becomes worn abnormally. As a result of this, it becomes extremely difficult to keep them in their proper position. That is why it has been found so difficult to make teeth, which have occupied positions of torsiversion, retain their proper position in adults. It is not because of the age of the patient but because of the abnormal approximal contacts. Therefore, the relative importance of the inclined plane and the interproximal contact as a factor in retention, changes during the lifetime of the individual.

The natural forces of retention must always be considered in the con-

ing appliance. The mechanical device must be done that will interfere with his view in mind we will pass to the es.

orces of Retention

y **Retention.**—The first form of me- e passive intramaxillary. In this form, hat has not been moved to hold a tooth l upon the large and favorably located been moved. It does not require much urning to its old position; therefore, as an be made very simple. It may be a 416. In making use of the band and ncerned, it makes no difference whether at has been moved or on the firm tooth. etention is the ease with which it can ooth as a base, no mechanical construc-

sive intramaxillary retention.

to assist in retention. Simple passive n used, for in most cases of malocclu- ve so many teeth that there are none n be utilized as the base for retention.

lary **Retention.**—Compound retention er of teeth that have been moved are t have not moved. This is the style of from lip habits, where the superior an- tward without disturbing the canines. e been placed in their proper position, with a wire running labial to the inci- , which will prevent the superior ante- This form of device is simple com-

great tendency for the corrected tooth retainer is made in such a manner that

it will exert an active force. This is accomplished by having the spur made from some material that possesses spring, and so made and adjusted that a spring force will be exerted upon the malposed tooth to overcome the backward tendency.

Stationary Intramaxillary Retention can be produced but is not desirable. In those cases in which the teeth are held rigid, it has been found that the normal cell metabolism is interfered with to such an extent that the teeth do not become firm. Therefore, every effort should be made to allow the teeth to respond to the forces of mastication as much as possible.

Reciprocal Intramaxillary Retention is used in those cases that have been regulated with reciprocal anchorage. It is the pitting of the backward tendency of one tooth that has been moved against the backward tendency of another tooth that has also been moved. The simplest form

Fig. 417.—Simple primary reciprocal intramaxillary retention.

of this principle is shown in Fig. 417 where two central incisors have been moved toward each other. By passing the ligature wire around them, one is made to retain the other. This is primary reciprocal retention of the passive variety—primary, because the appliance is holding only the teeth to which it is attached; passive, because there is no spring or pull in the ligature, which only occurs as the teeth try to return to their old position.

Compound Reciprocal Retention is where the backward tendency of two or more teeth is overcome by the backward tendency of two or more

other teeth, which are trying to return in an opposite direction. Furthermore, the appliance is so constructed that it is attached to less teeth than the number that are being retained. With this form of appliance we have the greatest working efficiency. Compound reciprocal retention is used in the active and passive form. Compound passive reciprocal intramaxillary retention is often employed in retaining the six anterior teeth. An example is shown in Fig. 418, in which the six anterior teeth have been moved. All of the teeth have been moved from positions of lingual occlusion. By placing bands on the canines and soldering a wire on the lingual sides of the bands so that it will engage the lingual surface of the incisors, the six teeth are retained by the one appliance.

Fig. 418.—Compound reciprocal intramaxillary retention; lingual bar.

The lingual tendency of the canines is overcome by each other and the backward tendency of the incisors is also overcome by the same appliance, which justifies the use of the term compound reciprocal intramaxillary retention. As there is no spring to the appliance, it only exerts force as the teeth try to return, being called passive retention. This principle can be carried further, and by placing bands on the molars and canines and soldering a wire on the lingual side of these bands, the retainer can be made to retain all of the teeth in the arch, if they have all been in lingual occlusion.

In using the lingual retainer just described on all of the teeth in one arch, it has been found that the force of the teeth may be greater than the passive force exerted by the appliance. As a result, the arch would

contract and the teeth would assume a position of malocclusion, much to the chagrin of the operator. To avoid this, active compound reciprocal intramaxillary retention was devised, which consists in making the lingual retaining wire out of some material that has a spring, and which is so constructed that the pressure of the spring can be regulated. If the teeth are exerting more force than is exerted by the retaining wire, the wire is removed from the small open tubes holding it in place and more spring given to the lingual wire, which makes the appliance of sufficient strength to hold the teeth (Fig. 419). By making an appliance of this kind we are able to have one of smaller bulk and have absolute control over the teeth at all times. There are other forms of

Fig. 419.—Simple compound reciprocal intramaxillary retention, with removable lingual bar.

retaining devices that utilize this principle, which are fully described in the chapter on treatment.

Intermaxillary Retention is where the force necessary to overcome the backward tendency of the teeth in one arch is derived from some teeth in the opposite arch. This form is primary and compound, active and passive, also simple and stationary. Primary passive intermaxillary retention is where the backward tendency of one tooth in one arch is overcome by a tooth in the other. The most common form of this retention is when the loss of the maxillary second deciduous molar makes it necessary to hold the maxillary first molar distally. This form of retention can be taken advantage of by cementing a pin on the occlusal surface of the mandibular second deciduous molar so as to engage the mesio-occlusal surface of the maxillary first molar. The favorable location of one tooth to the other makes possible this form of retention.

Active Primary Intermaxillary Retention is where the force necessary to overcome the backward tendency of a tooth in one arch is obtained from a tooth in the opposite arch. An example of this is shown in Fig. 420 in which a canine, which was in infra-occlusion, has been brought to the proper position. In order to retain it there a rubber band is attached to the mandibular first premolar.

Reciprocal Intermaxillary Retention is where the backward tendency of the teeth in one arch is overcome by the backward tendency of the

Fig. 420.—Retention of superior canine, which was moved from infra-occlusion retained by rubber band from lower premolar, which makes active primary simple intermaxillary retention.

teeth in the opposite arch. This may be primary or compound, but in most cases is compound. It may be used either active or passive.

Passive Reciprocal Simple Intermaxillary Retention is where the backward tendency of the teeth in one arch is overcome by the backward tendency of the teeth in the other arch, the appliance being so constructed and attached that the teeth will be tipped if sufficient force is exerted upon the appliance. The appliance is made so that it exerts force upon the teeth only as they try to return to their old positions. Should the appliance become bent or the teeth slip slightly, no force will be exerted, which will regain what has been lost. Passive intermaxillary retention has been used for some time in the retention of distoclusion with labioversion of maxillary anterior teeth or Class II, Division 1 cases, or in fact in any class of cases in which the mesiodistal relation of the teeth has been changed.

Plane and Spur Retention.—A form that was much used was described by Angle and has been known as the "plane and spur." It consists of a band fitted to an upper and lower tooth, generally to the

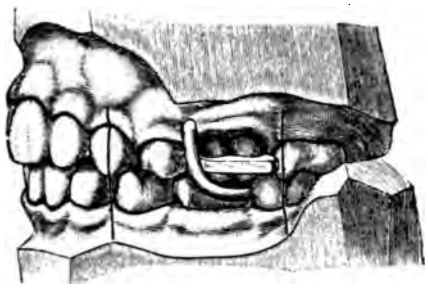


Fig. 421.—Plane and spur, which is passive reciprocal intermaxillary retention. (Angle.)

first molars, which have been chosen on account of their size and strength. A plane is soldered on the buccal surface of the upper band (Fig. 421) and a spur on the buccal surface of the lower band for the purpose, in distoclusion or Class II, of engaging the anterior part of the plane on the upper molar band. This retainer antagonizes the backward tendency of the teeth, but the disadvantages lie in its principle:

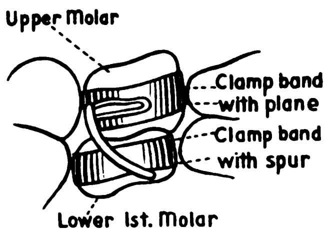


Fig. 422.—Shows how force of passive retention in Class II tends to tip upper and lower molars.

First, it depends only upon the firm location of the molar teeth to supply the resistance necessary to prevent the backward tendency of the teeth; second, there is no attachment or construction of the appliance that will give the teeth any assistance; and, third, the force is entirely passive, that is, if the teeth drop backward the least bit, there is no way of regaining the movement lost. It very often happens that the teeth to which this appliance is attached will be tipped, as shown in Fig. 422. This allows the teeth mesial and distal to the ones to which the appliance is attached to assume incorrect positions. Many different

forms of the plane and spur have been used and attached to different teeth, but the principle has always remained the same.

Passive Reciprocal Stationary Intermaxillary Retention is that form in which the teeth in one arch are made to overcome the backward tendency of the teeth in the other, the appliance being so attached that the teeth supporting it cannot tip at all. Figs. 423 and 424 illustrate very clearly what was intended to be done, but the great disadvantage was that it held the teeth too firm and for that reason this form of retention was used by the author only on one case.

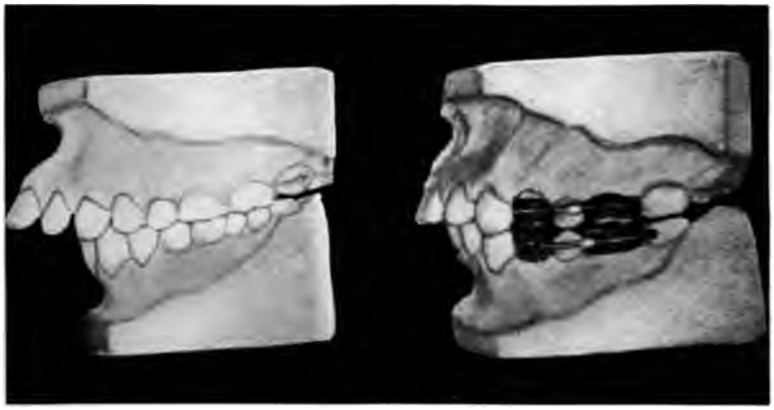


Fig. 423. Fig. 424.

Figs. 423 and 424.—Showing passive reciprocal stationary intermaxillary retention, which is a very unsatisfactory form to use.

Active Primary Reciprocal Intermaxillary Retention is where the force necessary to retain the teeth that have been moved in one arch is derived from the teeth that have been moved in the opposite arch, and is of an active nature. Various forms of this principle are employed—e. g., primary, when a tooth in one arch is used to retain a tooth in another arch. This form is used when a canine in the upper arch, which has been moved from intra-occlusion, is used to retain a lower tooth moved from the same position, by placing a band on both teeth and connecting them by means of a light rubber ligature. Fig. 425 illustrates such a condition.

Active Compound Reciprocal Intermaxillary Retention is used when the teeth of one arch are made to retain the teeth in the opposite arch, the teeth in both arches having been moved. This is the form of retention used in the retaining of cases caused by tongue habits. The use

of the rubber ligature that supplies the active force causes a better retention than the use of any other appliance.

Compound active reciprocal intermaxillary retention is most useful in the retention of Class II, or distoclusion, and Class III, or mesioclusion, cases. One form is shown in Fig. 426. The details of construction are discussed in the chapter on treatment of Class II, or distoclusion, and Class III, or mesioclusion, cases. The chief advantages of this

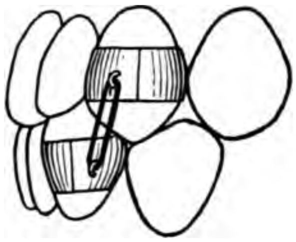


Fig. 425.—Active primary reciprocal intermaxillary retention used to retain canines that have been in infraversion.

form of retention are that it prevents the tipping of the molars and can be so adjusted as to aid the settling of the inclined planes of the teeth. The use of this form of retention has displaced all others in the author's practice for Class II, or distoclusion, and III, or mesioclusion, cases. It will be considered further in the treatment of cases.

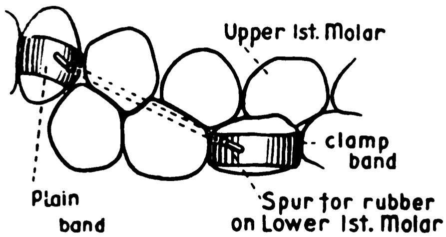


Fig. 426.—Compound active reciprocal intermaxillary retention used in Class II, Division I cases. (See also Fig. 643.)

Extramaxillary Retention is that form in which the force necessary to retain the teeth is derived from some source external to the oral cavity. It is derived from the occipital, cervical or facial region and is very little used. The author has never had occasion to make use of any of these forms.

CHAPTER IX

IMPRESSIONS AND MODELS

Preliminary Consideration of Cases.—One of the essential things in the treatment of cases is a thorough understanding of the conditions. The case must be studied with the object in view of learning the cause of the malocclusion. The history of the case should be gone into in order to learn whether nasal obstructions, constitutional conditions or habits have played a prominent part in the production of the malocclusions. Very little should be said in regard to the prognosis of the case until after the condition has been studied from models made from good impressions.

It is very necessary that an orthodontist should be able to take the impression skillfully and without annoying or agitating the patient. Many patients have been frightened away from the operator because of the crude manner in which he obtained the impression.

Taking the Impression.—In order that we may obtain the best impression possible—for without a good impression we cannot have a good model—plaster must be used. The advantages of plaster are so apparent that it is hardly necessary to mention them here. It is the only material that will give an accurate reproduction of the condition as it exists. The more pronounced the malocclusion the greater the need of plaster. In the hands of the skilled operator it is no more objectionable to the patient than modeling compound. Modeling compound has a place in dentistry, but not in orthodontia, for the making of record models. Modeling compound impressions can be used for study models and for models to be used in the construction of appliances, lingual arches and retainers. The teeth should be carefully cleaned, and the mucus removed from the teeth and gums as thoroughly as possible. A tray larger than the dental arch should be selected, being perfectly smooth on the inside and having high walls, as shown in Fig. 427. One with a quarter of an inch between the teeth, alveolar process and the edge of the tray is preferable. The tray should be of a material that will permit bending so that it can be shaped to the dental arch. The tray must be placed in the mouth and the cheeks and lips pulled over it, which enables the operator to observe how it fits and the patient to become familiar with the sensation. If the patient has a tendency to

gag or is frightened, the impression must not be taken until all fear is allayed, and a tray should be selected that will not produce nausea.

When about to take the impression, the patient is carefully protected with a suitable towel or large apron. It is unnecessary to distribute

Fig. 427.—Plaster trays.

débris of plaster upon the clothes of the patient, or to allow it to accumulate upon the floor of the operating room. All that is needed is an ordinary towel with the corners pinned up to make a pocket into which the excess pieces of plaster are dropped when the impression is being taken.

A quick-setting plaster should be chosen so that it will not be necessary to keep the material in the patient's mouth very long. A small plaster bowl (Fig. 428) holding the required amount of water is used, and the use of salt depends upon the rapidity with which the plaster sets and the ability of the operator to work rapidly.

The plaster is slowly sifted into the water until the water will take no more plaster. Then it is carefully removed from the bowl and placed in the tray, as shown in Fig. 429. A liberal amount of plaster should be inserted around the buccal and labial parts of the tray, but none should be placed in the palatal part. The tray is placed in the mouth and the part of plaster that has been placed on the labial part and handle of the tray, is carefully worked under the lip and cheek. This is done to be certain that no air is caught between the lip and impression. After the plaster has been placed under the lip, care must be taken that the impression tray is in the proper position—not too far distally or mesi-

Fig. 428.—Plaster bowl, which must be smooth inside, so that hard plaster can be removed.

ally, nor too far to the buccal, and straight with the median line of the face. If, in forcing the upper tray into place, some of the plaster is forced over the palatal part of the tray, it should be removed at once with a mouth mirror. In taking the lower impression, just before the tray is forced down and after the plaster has been placed under the lip, the patient should be instructed to raise the tongue, and while the tongue is raised, the tray is forced down. This insures a good impression of the lingual part of the mouth. Also, the fingers should be passed back to the disto-buccal part of the tray and the cheek forced buccally; for often the cheek is caught under the heel of the impression tray, thus spoiling the accuracy of the impression.

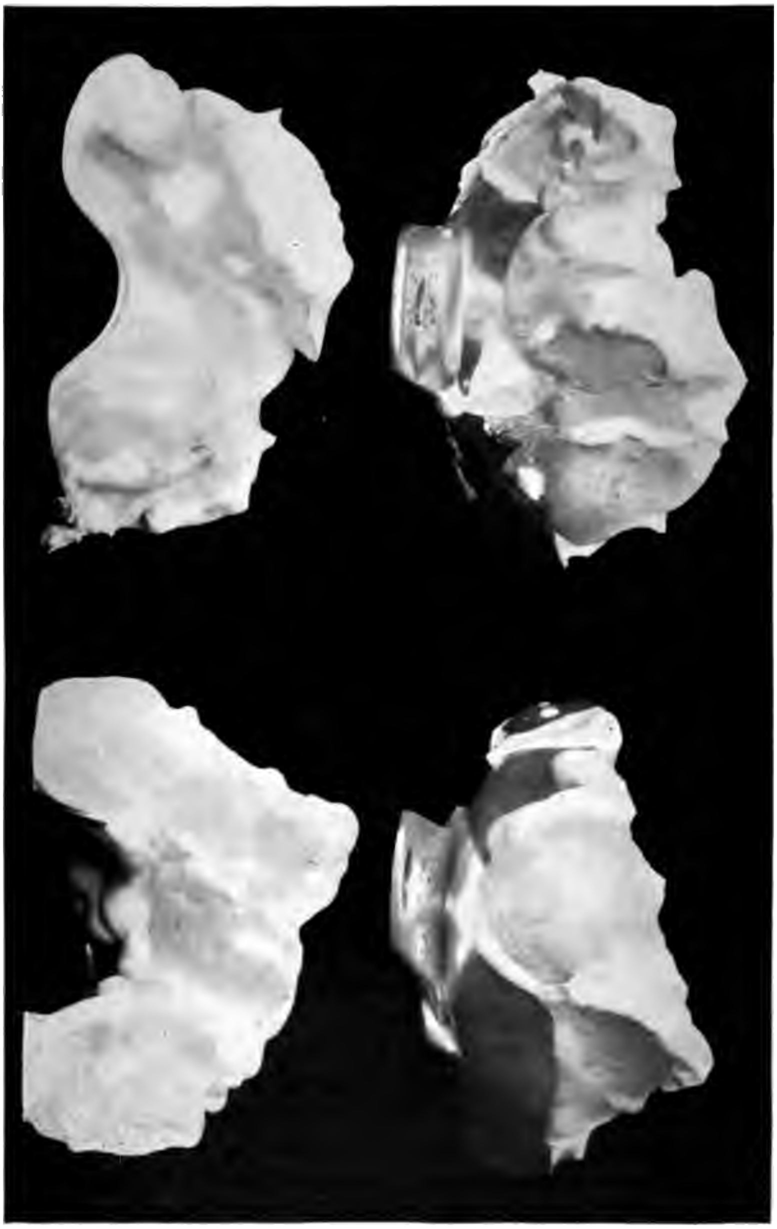


Fig. 429.—Manner of placing plaster in trays so that excess can be worked under lips.

The tray is held firmly until the plaster begins to set and then pieces of cotton or bibulous paper can be used to wipe the saliva out of the mouth and to remove the loose pieces of plaster. After the plaster is hard enough to hold the tray in place, the part of plaster on the outside of the tray is removed. Any part that breaks off below the border of the tray should be saved, others are thrown into the pocket made by pinning the towel at the corners. After all pieces of the plaster have been broken away from the tray, the tray is then removed, leaving the impression intact in the mouth. With a sharp knife, using a chisel stroke, grooves should be made in the impression over the canine eminences, as that is the most convenient way to break the impression. These grooves should be made narrow with straight walls, as the straight walls are necessary to use as a fulcrum for the knife blade in breaking away the plaster. The positions of the teeth should be fixed in mind, and the lip pulled out of the way so as to get an idea of the anatomy of the parts, and the grooves cut through the plaster only far enough to permit it to break. The blade of the knife is placed in the groove and one piece is pried out. Whether the center piece or the side pieces are broken away first depends upon the position of the teeth. In breaking the buccal parts away, the thumb should be placed against the anterior end of the broken plaster and the finger placed along the buccal side of the same so as to protect the cheek. After the buccal and labial parts have been removed, the palatal part is then taken out. Occasionally an upper impression can be taken out in three or four pieces, but a greater number would not spoil the value of the impression. In removing the lower, the same procedure is followed. The lingual part is broken as near the median line as possible by pushing lingually on one side of it from about the region of the first molar. In removing the pieces, those from the right side should be laid on the right side of a blotter or piece of clean paper and those from the left side, on the left side of the blotter, and all the other pieces placed in their respective relations on the paper. The pieces of the impression must be laid away until they are dry and then placed together and held by sticky wax. In putting these impressions together, the small pieces of the right side must be stuck to the large pieces of the right side, and so on, and then the right and left parts of the impression put together. If trouble is encountered in getting the halves of the impression to stay together, they can be braced by sticking a match across the back with sticky wax. Figs. 430 and 431 show the upper and lower impressions as they are removed from the mouth. Fig. 432 shows the appearance of the upper and lower after they are put together.

Varnishing the Impression.—The impression is then coated with a separating medium. The author has obtained the best results from the use of shellac and sandarac varnishes, as recommended by Angle. The consistency of the varnishes can be learned only from experience.

Fig. 430.

Fig. 431.

Figs. 430 and 431.—Impressions removed from mouth, 345, upper impression; 346, lower impression.

Fig. 432.—Impressions put together with sticky wax.

Alcohol must be added to the varnishes from time to time to keep them thin enough. One coat of shellac is placed on the impression with a fine brush from a solution so thin that all of the shellac will soak into the impression. If this first application leaves a coating on

the impression, the varnish is too thick and the impression will not produce a good model. The object of this coat is to fill all of the pores in the impression, color the impression for a certain distance, and act as a filler for the next coat. The second coat is applied only after the first is thoroughly dry, and at least three hours should elapse after the first coat is put on before the second is applied. This second coat should cover the entire surface of the impression, and is taken from the same bottle as the first. The purpose of the second coat of shellac is to fix a gloss on the impression. After this second coat it would be possible to separate the impression from the model, if it was poured then. However, in order that the teeth may have a

Fig. 433.—Impression poured before being turned over on glass slab.

better gloss and that the impression may be separated more readily, a coat of very thin sandarac is placed in the impression of the teeth and the rough parts of the impression. Care must be taken not to get any of the sandarac on the gingival margins of the teeth. After the last coat of varnish is dry, the impression is ready to pour.

Pouring the Model.—The plaster used for the model should be one that will be reasonably hard and must not set too slowly. The plaster is carefully sifted into the water so as to avoid bubbles. When the water has taken up all of the plaster, the mixture is placed in the impression of the teeth with a fine brush. In filling the impression, begin at one side at the last tooth or heel and fill from there entirely

around the impression. The plaster is carefully placed in the teeth so as to expel any air bubbles that may occur in their cusps. After the teeth have been filled with the brush, the remaining part of the impression can be filled with the spatula, and a large amount of

Fig. 434.—Impression turned over and placed on glass slab.

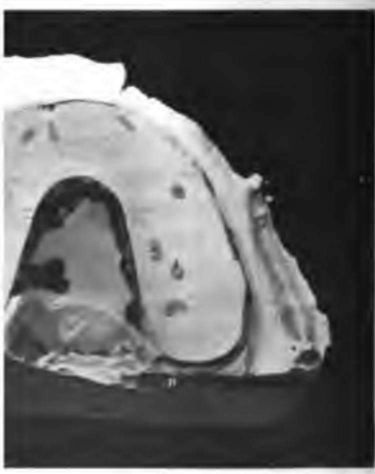
Fig. 435.—Impression removed from glass slab, showing square corners.

plaster should be placed on the impression, as shown in Fig. 433. By this time, the plaster should be hard enough to support the weight of the impression and also stiff enough so that it will not run out when turned upside down. The impression is now turned upside down on

434, and the plaster pulled up around
:al corners of the plaster must be left
for the reason that they represent the

r the plaster has become hard the im-
ed from the model. The plaster is

n border of impression previous to separation.



rimmed to show discoloration from shellac varnish.

f the impression until the border can
s the preliminary trimming and Fig.
occlusal portion until the stain of the
is then cut into the impression as near

the gingival portion of the teeth as possible so that it will extend from the right distal corner to the left distal corner (Fig. 438). Then grooves are cut parallel to the long axis of the teeth and at right

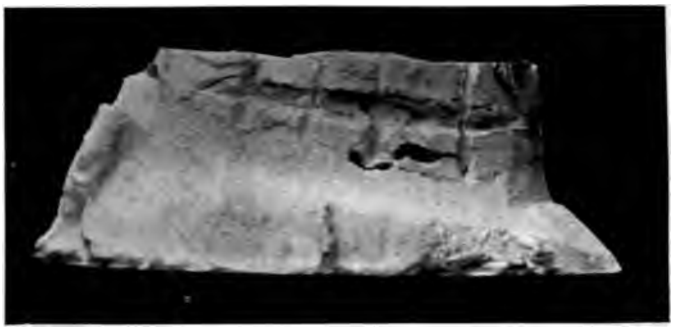


Fig. 438.—Grooves cut into impression before separation.

angles to the first groove. These grooves are carefully cut into the impression until the stain from the shellac shows. The pieces are then pried off by prying toward the occlusal surface. No piece of impression larger than a tooth should be removed at one time. When prying off the impression, care must be taken not to break off the teeth.

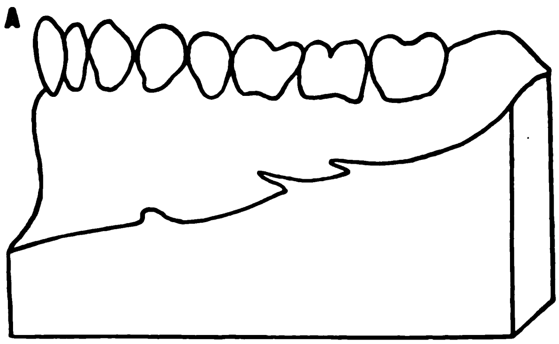


Fig. 439.—A to C represents height of model; A to B, the anatomical portion of model; C to B equals one-third of distance from A to B; A to B equals three-fourths of height of model.

Trimming the Model.—After the impression is removed, the model is then ready to be trimmed. The part of the model representing the teeth and alveolar process is known as the anatomic portion. The

rest of the model is known as the base or art portion. In handling the model, the anatomic portion should not be touched with the fingers.

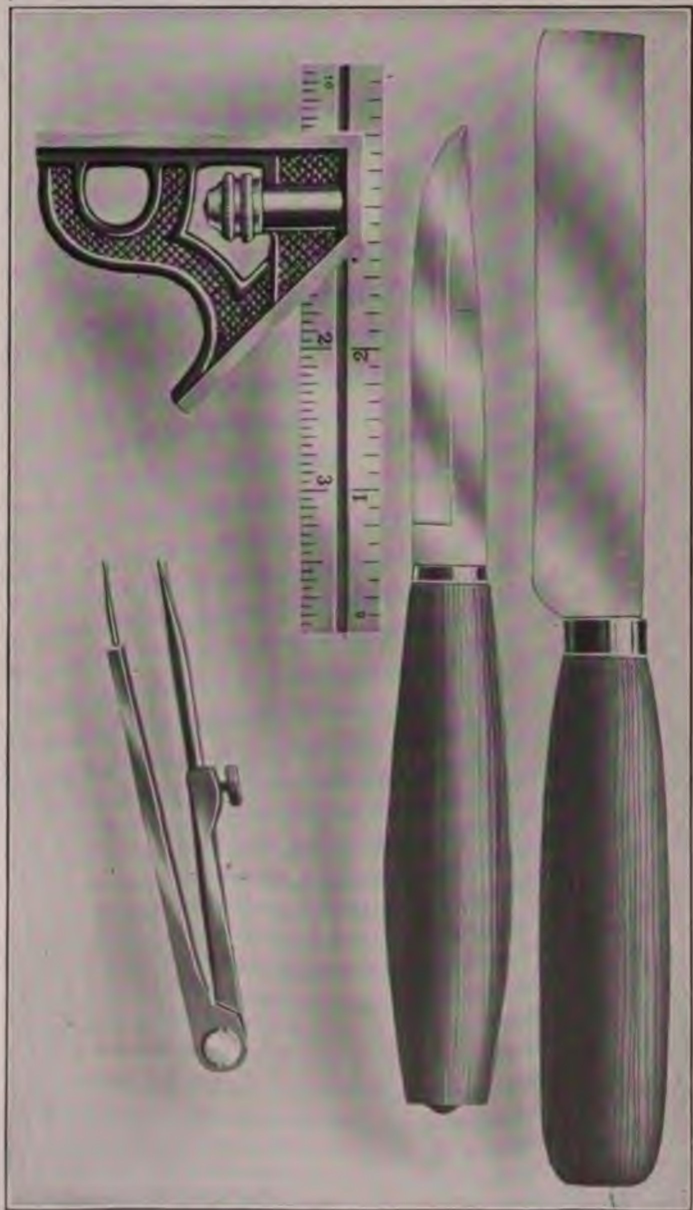


Fig. 440.—A group of instruments used in trimming the model.

The anatomic portion of the model is measured in the highest part and that length represents three-fourths of the height of the completed model. Therefore, the art portion of the model is one-third of the height of the anatomic portion. These measurements

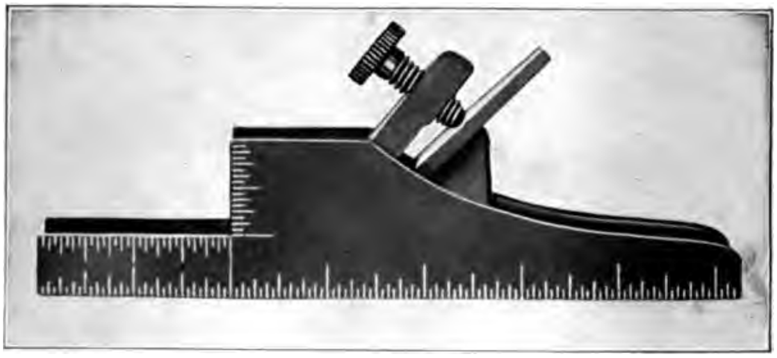


Fig. 441.—Plaster plane, used in trimming the model.

Fig. 442.—Taking measurement from the median line to a point distal to the molars.

can better be understood by referring to Fig. 439. After these measurements have been obtained, the art portion of the model is marked on all sides and then the base is trimmed to the line. The lower model

should always be trimmed first. The base should be finished smooth before any side is trimmed.

Fig. 443.—Model with base and back trimmed. Back must be at right angles to base.

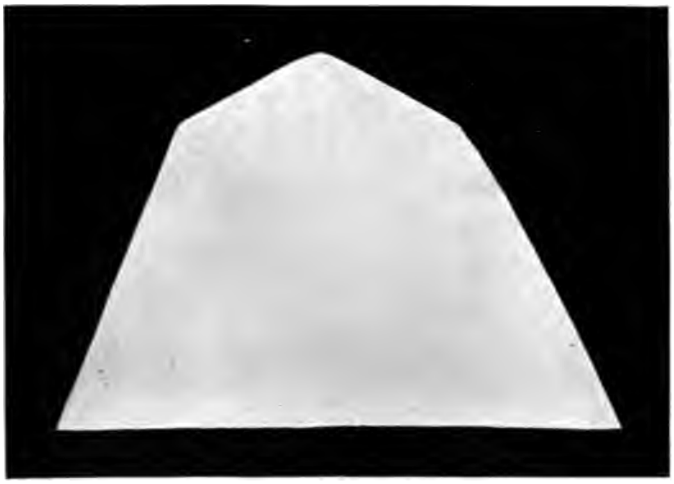


Fig. 444.—Sides trimmed at right angles to base.

In order to properly trim the art portion of the model, it is necessary to have a small square, a pair of compasses, one or two sharp

strong knives (Fig. 440), and a plaster plane (Fig. 441). The plane will be found very difficult to manipulate at first but when used properly it gives a finish that can be obtained in no other way.

After the base has been trimmed and finished with the plane, a

Fig. 445.—Appearance of base of model after the anterior corners have been established and the front marked with compasses.

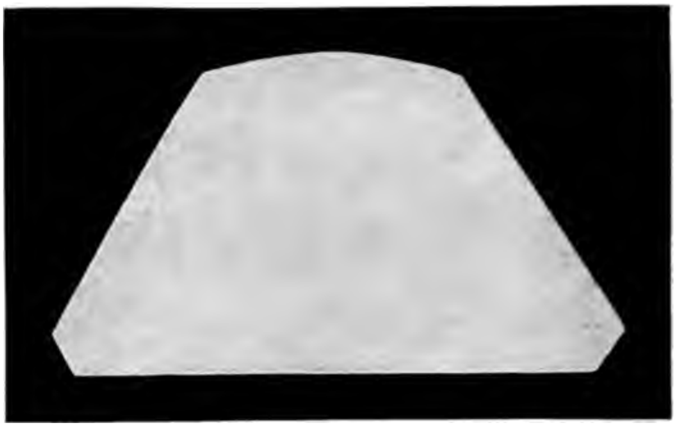


Fig. 446.—Distal corners of model trimmed at right angles to mesial corners.

measurement is taken from the median line to a point distal to the molars (Fig. 442). This point distal to the molar establishes the distal portion of the art portion of the model. It is trimmed straight across and at right angles to the base (Fig. 443). The sides are then trimmed and form a straight line parallel with the lines of occlusion

from the molars to the canine, being trimmed only close enough to the anatomy to get all of the overhanging edges (Fig. 444). Care must be taken to hold the knife at right angles to the base, for the side must be trimmed at right angles to the base. Very often the sides are trimmed so close to the anatomic portion as to ruin some

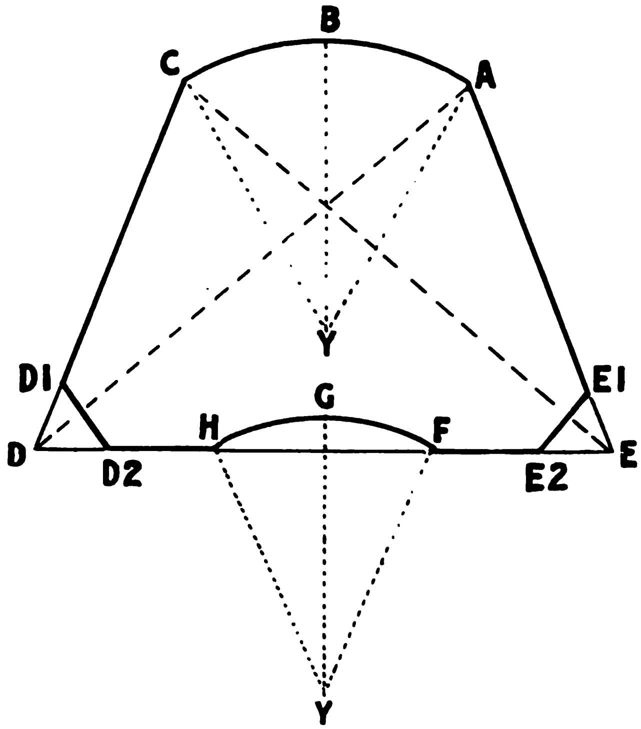


Fig. 447.—A, B, C are points on the arc of circle, the radius of which is the distance from A to C. F, G, H are points on circle, the radius of which is the distance from A to C. E1 to E2 and D1 to D2 are trimmed at right angles to lines running from C to E and A to D, which are one-fourth of distance A, B, C. The arc H, G, F is centrally located between D2 and E2. The different parts of the model should be trimmed in the following order: (1) The base; (2) the back from D to E; (3) the sides A to E and C to D; (4) the front A, B, C; (5) the corners D1, D2 and E1, E2; (6) the arc F, G, H.

of the anatomy and greatly mar the beauty of the model. The anterior part of the model is now trimmed. A mark is made on the side in the region of the canine to represent the corners, as shown in Fig. 445. After these corners are established, the compasses are placed on each mark and the distance between the two points represents the radius of a circle. The anterior part of the lower model is then

trimmed to represent the arc of a circle, the radius of which is the distance from one canine point to the other. Then the distal corners of the model are trimmed at right angles to a line passing from the

Fig. 448.- Base of completed lower model. Front trimmed round.

Fig. 449.—Base of completed upper model. Front trimmed to a point.

canine point to the opposite distal point (Fig. 446). The distal corners are trimmed so as to be one-fourth the length of the arc of the circle that forms the front of the art portion of the lower model

(Fig. 447). The distal part of the base of model is divided into fourths, and two-fourths are used in making a curve as shown in Figs. 447 and 448. This distal curve represents the arc of the circle, the radius of which is the distance from one canine point to the other. The curve in the front and the curve in the back are then arcs of circles that have the same radius. The base of the model then appears as shown in Figs. 447 and 448. Fig. 449 illustrates the base of

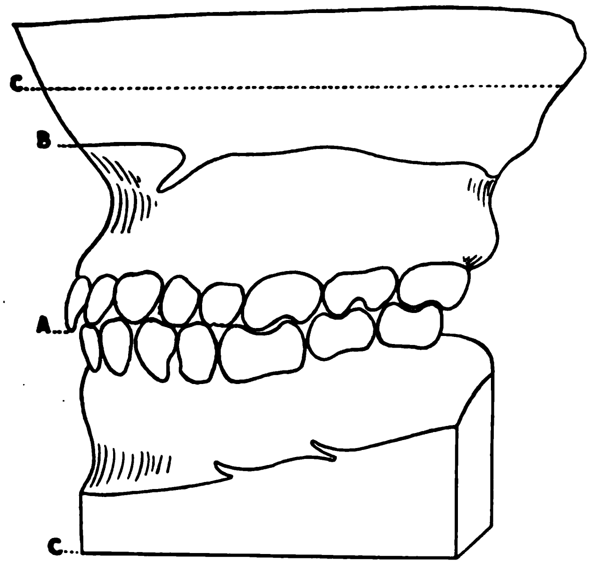


Fig. 450.—Method of obtaining the measurements for the anatomic and art portions of the upper model. Measure the anatomic portion of upper model, which is three-fourths of height of completed model. Then add one-third of distance from A to B, set square and make mark at C. Place upper model on lower model and measure from C on upper to C on lower, with teeth in occlusion. Make a scratch all around upper model with square, as shown by dotted line.

an upper model, which is trimmed as follows: The anatomic portion is measured in the same manner as described above, and the height of the art portion established in the region of the median line. The anatomic and art portions of the upper model are obtained as shown in Fig. 450. Upon the upper model a line is circumscribed around its entire circumference, and the base is then trimmed. The distal line and sides are obtained in the same manner as in the lower model. The canine points are then fixed but the front of the upper model is made pointed, as shown in Fig. 450. The anterior angle is a point on the arc of a circle, the radius of which is the distance be-

tween the canine points. The distal corners are trimmed the same as they were in the lower, except that they are made one-third of the length of the line from the canine point to the center of the model. The distal curve is obtained in the same manner.

Models when trimmed this way are well balanced, and if care has been exercised all through the procedure, there is no necessity to apologize for their appearance.

Modeling Compound to Study Models.—Study models can be made from modeling compound impressions at any time during the treatment of the case. They are made for the purpose of comparing the progress of treatment with the original model made at the beginning of the case. They can be made by taking an impression of the teeth,

Fig. 451.—Modeling compound shaped for the taking of impression from which study models are made.

Fig. 452.—Modeling compound impression for the making of study models.

using a tray in the usual manner, and taking an impression of each arch separately. They can also be made by having the patient bite into a piece of soft modeling compound, which is shaped as shown in Fig. 451. This piece of soft modeling compound is placed in the mouth in such a position as to include the posterior teeth, and the patient is instructed to close the mouth. The buccal and labial parts of the modeling compound are worked around the teeth, up under the lips, and the patient is instructed to close the lips while the cheeks are manipulated in such a manner as to work the impression material well toward the gingival border of the teeth. The lips are held apart, and the modeling compound is chilled by having cold water sprayed on it while the patient leans over the cuspidor. After the buccal and labial parts have been chilled, the mouth is opened by the pulling of the lower teeth from the impression by the patient, and while the impression is still in place on the upper teeth cold water is sprayed on

the palatal part of the impression. By chilling the palatal part after the lower teeth have been removed from the impression, and while the upper teeth are in place, any great amount of warpage is prevented and the impression will be fairly accurate, although not so accurate as a plaster impression would be. The appearance of the impression upon removal is shown in Fig. 452. These study impressions can be made in a few minutes with the appliance in place, and serve as a valuable means of checking up the treatment or retention. In pouring the study impressions, the models should be poured so that there will be an extension to the distal of the molars on the upper and lower models to act as a guide in placing the models in the correct position. These guides on the posterior parts of the models are extremely valuable in cases in which the anterior teeth are in infra-occlusion. The appearance of the study model is shown in Fig. 453.

Fig. 453.—Study model made from modeling compound impression. (Lourie.)

Duplicating Orthodontia Models.—Very often one desires to make a duplicate from the original model. In order to do this it is necessary to use some process that will injure the original model but little and still give a reproduction or duplicate that will be accurate. Several processes have been devised, all of which are more or less similar. The plan described by Hoggan* is as simple as any and requires as little special equipment or material as any process. It is as follows:

"Flake glue (Fig. 454) is prepared in thin chips about one-thirty-second inch in thickness. It is the glue that is used for duplicating plaster decorations on ceilings and statuary. The ordinary variety of glue is not suitable for this purpose. A tin dish about 8 inches long,

*Hoggan, J. A. C.: Duplicating Orthodontia Models, International Journal of Orthodontia, July, 1915, vol. i, p. 357.

4 inches wide and 3 inches deep (Fig. 455) is the right size to contain two models and sufficient glue. An ordinary double boiler, the inside portion to contain about two quarts, completes the necessary apparatus. The inside portion of double boiler is filled with flake glue, and sufficient cold water is then added to cover. This is allowed to stand until the glue becomes softened, usually about thirty minutes. Half of the water is then removed from the glue. Water is placed in the

Fig. 454.—Flake glue. (Hoggan.)

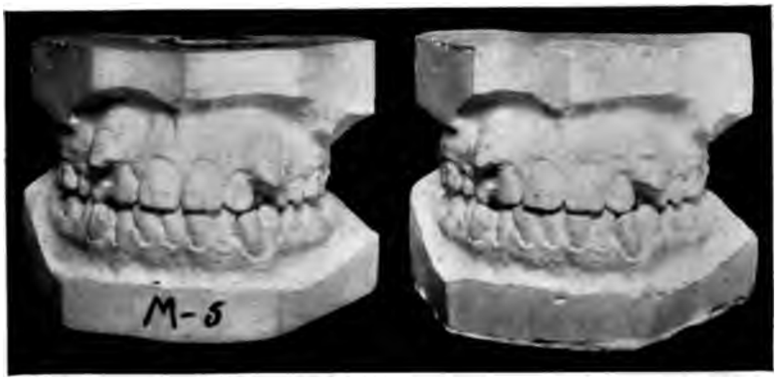
outer boiler, the two parts of the boiler put together and placed over the flame. It is allowed to heat until the water in the inside boiler rises to the top of the glue. The double boiler is then removed from the flame and the whole mass is allowed to stand until liquid, after which the inside boiler is lifted out of the hot water in the lower portion, and the glue allowed to stand until a scum begins to form on the surface, when it is ready to pour. The models to be duplicated are first thinly coated with vaseline and placed in a tin dish with teeth

presenting upward (Fig. 455) and the glue poured over them. The secret of the success of this process is to make the mass of glue liquid at the lowest possible temperature, then to pour it over the models at

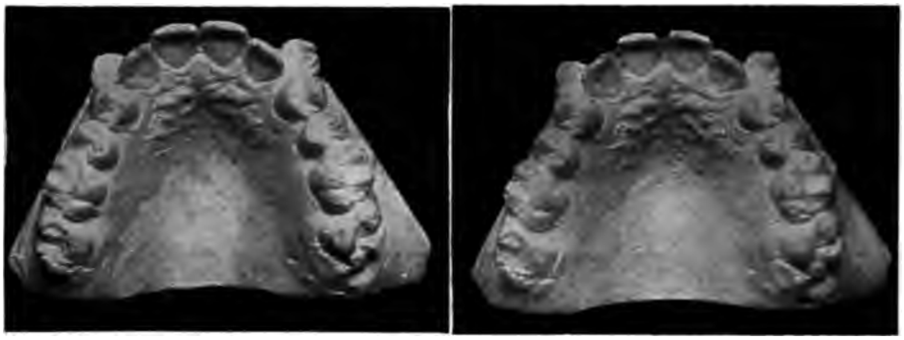
Fig. 455.—Tin dish with models placed in bottom ready to be poured with glue. (Hoggan.)

Fig. 456.—Glue impression after models have been removed. (Hoggan.)

the moment in which it is still liquid, but beyond which it would congeal. If models have a tendency to rise in liquid glue, they may be



Original. Fig. 457. Duplicate.

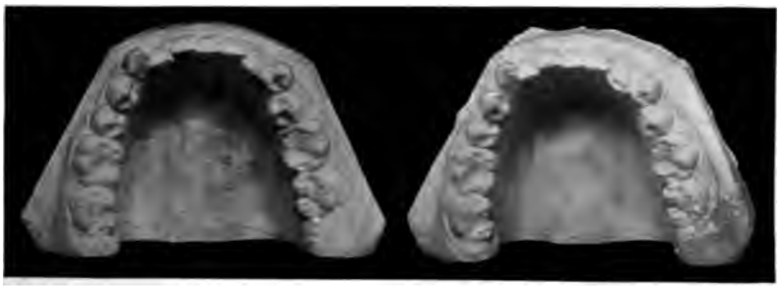


Original. Fig. 458. Duplicate.

Original. Fig. 459. Duplicate.

Original and duplicate models. (Hoggan.)

cemented to the bottom of the pan with a little sticky wax. This is allowed to stand in a cool place for at least twelve hours, after which congealed glue is removed from the pan and the models are carefully lifted out by springing the glue aside. The glue impression is now ready to pour (Fig. 456) with plaster of Paris. These models may be removed from the impression in ten minutes but are set aside for an hour to allow the surface of the model to set, it being softer than ordinary models for the depth of one-quarter inch. Figs. 457 to 461 show models removed from the glue impression. The models are



Original. Fig. 460. Duplicate.
Original and duplicate models. (Hoggan.)

Original. Fig. 461. Duplicate.
Original and duplicate models. (Hoggan.)

then retouched, and if desired several sets can be reproduced from the same glue impression."

Photographs.—A valuable adjunct to the records as supplied by models is the use of photographs of the patient, and facial casts. There are advantages in both the photograph and the cast. In taking photographs of patients, a side view and a front view should be secured. The side view should be a full profile, which sometimes is rather difficult to get owing to the fact that the photographers do not

always pose the patient so as to give the best results. Photographs which show the proper poses are shown in Figs. 462, 463, 464, and 465. With those patients who are mouth-breathers it is sometimes well to take a front view showing the lips closed and one showing them

Fig. 462.—Showing abnormal facial outline due to mouth-breathing. (Parsons.)

Fig. 463.—Showing fairly normal outline due to forced normal breathing. (Parsons.)

Fig. 464.—Showing fairly normal profile due to forced normal breathing. (Parsons.)

Fig. 465.—Showing abnormal profile due to mouth-breathing and distoclusion. (Parsons.)

parted, as shown in Figs. 462 and 463. The profile taken in the same manner is also shown in Figs. 464 and 465. The photographs can be easily obtained without any discomfort to the patient, and for that reason they have been much used during the last few years. They are not so satisfactory in some other respects as facial casts.

Facial Casts.—Facial casts show the different facial developments better than does the photograph and are especially desirable in those patients who have unequal developments in the two parts of the face. Facial casts are divided into the full cast and the profile; we also have partial facial casts and the full facial cast with the dental insert.

Profile Cast.—The technique of making the profile cast will be given first, as it is probably the more easily made. The patient is placed in a comfortable position in the chair, or better still lies on a table. A piece of soft lead wire, or fuse wire, is made to fit the facial profile by starting with the wire at the top of the cranium and adapting it to the anatomic curves along the median line of the face, along the nose, upper lip, lower lip, chin and neck, as shown in Fig. 466. When this is done, the wire is carefully removed and laid on a piece of heavy cardboard and pushed down sufficiently hard to make an indentation in the cardboard, and the outline of the wire is carefully marked on the cardboard with a pencil. The cardboard is then cut out to fit the face, as shown in Fig. 467. This cardboard must fit the facial profile carefully, for it will serve as a means of limiting the plaster to the part of the face that is to be included in the facial cast, and will prevent annoyance to the patient from the spreading of the plaster over more of the face than is necessary. The side of the face that is to be included in the profile is then coated with thin vaseline, which has been liquefied by placing the jar of vaseline in warm water. The vaseline should not be completely liquid but should possess enough body so that it may be applied with the aid of a shaving brush. The vaseline is placed over all parts of the face that are to be included in the profile cast, including the hair, eyebrows, eyelashes, the ear, the nasal opening, mouth, cheeks, lips and neck. Especial care must be taken to paint sufficient vaseline on the hair and eyebrows so that they will not adhere to the cast. The eyelashes must also have enough vaseline on them so that they will pull free from the facial impression. If there is any fine hair on the face it must also be carefully painted down with vaseline to avoid the discomfort to the patient that will be experienced in the removal of the cast should the hair cling to the cast. A piece of cotton containing vaseline should be placed in the side of the nose that will be included in the impres-

Fig. 466.—Adjustment of fuse wire to center of face. (Oliver.)

Fig. 467.—Cardboard trimmed to fit outline of face. (Oliver.)

sion. A piece of cotton should also be placed in the opening of the external ear, and a piece of cotton saturated with vaseline should be placed behind the ear to prevent the plaster from filling the space behind the ear so closely as to prevent the removal of the cast from the ear. After the face and parts have been thoroughly covered with vaseline, the patient's head is turned so that the part of the face to be included in the impression is turned upward, and the piece of cardboard is placed on the face to prevent the plaster from spreading over the face beyond the desired area. The plaster is mixed in a large mixing-bowl, one that will hold at least two quarts of the mixed

Fig. 468.—Profile impression on face with cardboard removed. (Oliver.)

plaster. The first plaster that is placed on the face should not be thick enough or stiff enough to displace the parts and should be carefully worked into the fine lines and concavities of the face. After this first thin layer of plaster has begun to set, more plaster can be added to give the impression the desired thickness. In taking a facial profile cast, it is necessary to have an assistant who holds the cardboard form in place, and also one who assists in getting the plaster on the face, as the plaster must be laid on the face very rapidly so that it will not set in patches, or that part of it will not begin to set before the entire face is covered. It is often necessary to make a second mixture of plaster to strengthen the first that has been placed on the

face. After the impression is set the cardboard can be removed, leaving the impression in place, as shown in Fig. 468. After the impression is thoroughly hardened, it is carefully lifted from the face. If sufficient vaseline has been placed on the hair, eyebrows, and eyelashes, they will pull away from the impression without any discomfort to the patient. Should the hair cling to the impression, it can be carefully worked loose by pushing the skin away from the cast with the fingers or a spatula. After the impression is removed, it

Fig. 469.—Facial impression grooved for separation. (Oliver.)

should be thoroughly dried and then given a coat of shellac varnish, the same as is used in a plaster impression of the mouth. If there are any small air bubbles or other imperfections, they can then be filled up by the use of a brush with dry plaster and water. The coating of shellac will furnish a line of demarkation so that the plaster can be added only where it is desired. A second coating of shellac is then

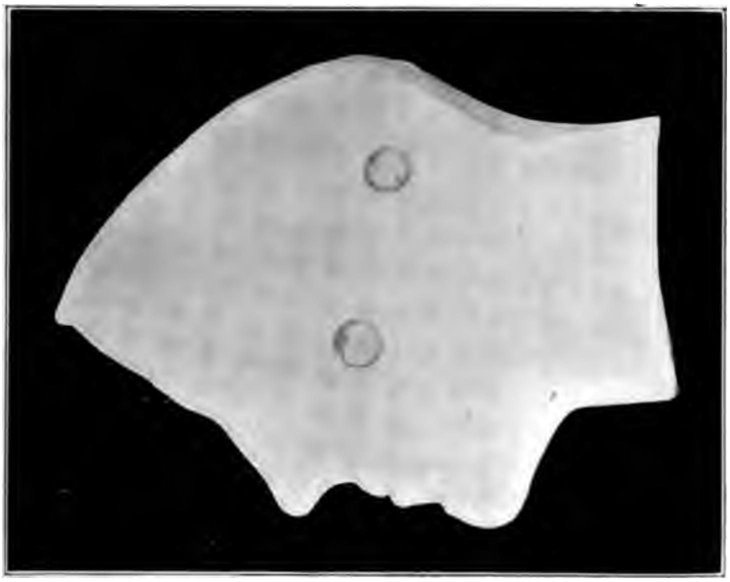


Fig. 471.—Back of profile cast. (Oliver.)

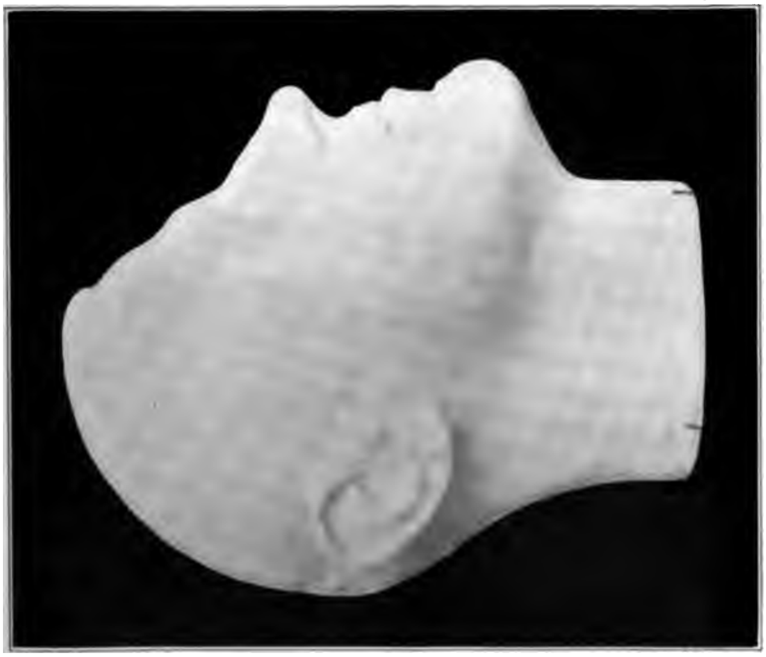


Fig. 470. Front of profile cast. (Oliver.)

placed on the impression, and after it is dry a coating of sandarac varnish is applied. After the sandarac varnish is dry, the impression is ready to pour, which is done by mixing enough plaster to entirely fill the impression to about the thickness of half an inch. This mixture of plaster is poured in the impression and the impression turned from side to side to get the plaster into all of the fine lines and to distribute it equally inside the impression. Immediately, a second mixture is placed in the impression for the purpose of increasing the thickness and of giving it more strength. After the cast has become hard, the impression can be removed in the same manner that a

Fig. 472.—Fuse wire used to get outline of face for partial facial cast. (Oliver.)

plaster impression is removed from the teeth. Deep grooves are cut in the impression, as shown in Fig. 469, until the discoloration of the shellac is seen. Care must be observed in removing the ear, lips, nose and eyebrows. After the impression has been removed, the cast can be trimmed to bring out the profile, and the imperfections can be remedied with the use of plaster and a brush. Fig. 470 shows the finished profile cast, front view. The back of the profile cast is completed by cutting holes in the plaster, into which two corks are inserted and pasted by placing some soft plaster around them. Screweyes can then be placed in the corks, and the cast hung up, if so desired (Fig. 471).

Partial Facial Cast.—A partial facial cast includes only a part of the face and does not include the ears, or one ear, as does the profile cast. They are much easier to make as they are easy to remove and may not include the hair or eyes. They are made by taking a piece of cardboard and by cutting a hole in it large enough to include the chin, mouth, part of the cheeks, and the nose. Provision has to be made for the patient to breathe through the nose, and rubber tubes are placed in the nares through which the patient breathes. These tubes should not be so large as to distort the nose, yet they must be large enough so that the patient can breathe through them with comfort. The partial facial cast can also be extended so as to include the

Fig. 473.—Cardboard in place for the partial facial cast showing rubber tubes in nose. (Oliver.)

eyes, in which case the technique consists in taking a piece of fuse wire and in making an oval to include the parts of the face that are to be included in the cast. The fuse wire is shaped as shown in Fig. 472. This piece of wire is then laid over the piece of cardboard and serves as a pattern for cutting the cardboard that fits over the face, as shown in Fig. 473. The position of the rubber tubes is also shown. In order that the end of the tube can be held away from the lip, a piece of string is fastened to it. The assistant can hold the rubber tube out of the way while the plaster is being placed around the tube. Care must be observed not to displace the rubber tube or the breath-

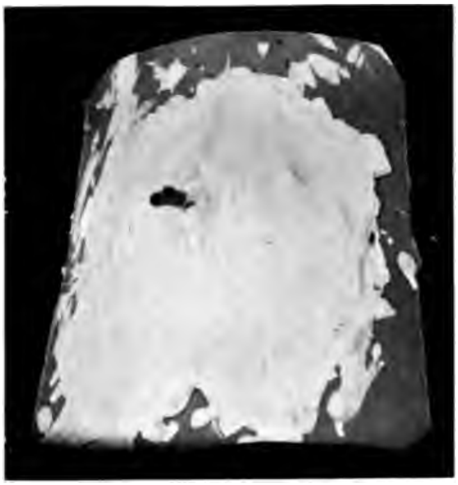


Fig. 474.—Impression for partial facial cast showing position of tubes and cardboard. (Oliver.)

Fig. 475.—Partial facial cast. (Oliver.)

ing of the patient will be interfered with and the impression will be spoiled. The face is, of course, coated with vaseline in the same way as it was in the profile casts, and the plaster is applied to the face in

Fig. 476.—Partial facial casts. (Parsons.)

Fig. 477.—Partial facial casts. (Parsons.)

the same manner. The appearance of the face covered with plaster, and the position of the rubber tubes and the cardboard, are shown in Fig. 474. The impression is varnished in the same way as was the

impression of the facial profile, and poured and separated in the same manner. Fig. 475 shows the facial cast, front view, which does not include the ears. Fig. 476 shows the side view of a partial facial cast, and Fig. 477 the front views.

Full Facial Cast.—In making a full facial cast the fuse wire is adjusted to the face and cranium so as to include the ears and chin and as much of the cranium as is desired. It is generally necessary to include only that part of the cranium as far back as the ears. A piece

Fig. 478.—Full facial cast with dental insert. (Oliver.)

of cardboard is then cut to fit the face and the face is covered with vaseline as in the other impressions. After the face has been covered with vaseline, the plaster is applied to the face in the same manner as in the profile, and when the first coat or layer of plaster has been reënforced, the facial impression is removed. In some instances the full facial impression can be removed in one piece, and in other cases it will be necessary to break it in order to free it from the posterior part of the mandible. The impression is varnished and poured and separated in the usual manner.

Full Facial Cast With Dental Insert.—The full facial cast is also made with an insert of the teeth, an example of which is shown in Fig. 478. It will be observed that the teeth are shown in the full cast, and that they occupy the same relation in the cast that they occupy in the face. This makes possible the study of the teeth in relation to the face in a manner that has never before been possible without the insert cast. In making the dental insert, the face is coated with vaseline, and the rubber tubes are placed in the nose, as is shown

Fig. 479.—Impression of teeth and face for the dental insert. (Oliver.)

in Fig. 473. It is not necessary to use a cardboard to control the plaster in making the dental insert. The patient holds the teeth together, the lips are separated, and soft plaster is worked between the teeth and the cheeks as far distally as the last tooth. A good amount of plaster is placed in the oral vestibule so as to include all of the alveolar process on the buccal sides and on the labial side of the teeth, and thus give the necessary strength. After the oral vestibule is full of plaster, it is continued over the face, covering the chin, nose, and median part of the forehead. It is necessary to have the facial part of the dental insert impression cover the points mentioned on the

face in order to have three points that are fixed for the placement of the insert in the facial impression. The appearance of the dental insert impression after the plaster has been placed over the chin, nose, and forehead is shown in Fig. 479. The impression is then varnished in the same manner as are the other facial impressions, and is shown in Fig. 480. The impression is poured, and after the removal of the dental insert cast, the facial parts are trimmed away, leaving only three points untrimmed, which are the tip of the nose, the center of

Fig. 480.—Facial and dental insert impression varnished. (Oliver.)

the forehead, and the tip of the chin (Fig. 481). This trimming is done to allow the plaster that is poured in the full facial impression to flow around the dental insert at all points, except the three points mentioned and the part that is protected with wax, as is shown in Fig. 482. The part of wax that is shown in Fig. 482 is to prevent the plaster from flowing over the entire dental insert when it is placed in the facial impression and when the facial impression is poured. The wax protection is made by taking a piece of soft wax, molding it over the side of the dental insert, and then trimming it approximally. The wax can then be warmed, and the dental insert with the wax in position

Fig. 481.—Dental insert cast ready to be placed in facial impression. (Oliver.)

Fig. 482.—Wax protection of side of dental insert to prevent plaster from flowing over teeth (Oliver.)

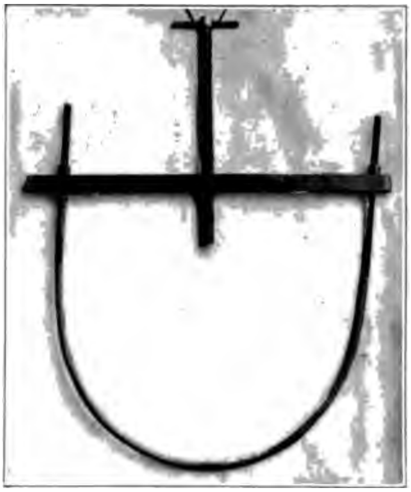


Fig. 483.—Clamp for holding dental insert in facial impression. (Oliver.)

Fig. 484.—Dental insert in facial impression. (Oliver.)

is placed in the facial impression with the point of the nose, forehead, and chin in the proper relations, and the wax forced into the proper form and shape. The dental insert can then be removed and the wax added to or trimmed as desired. After the wax has been properly shaped, the next step is to hold the dental insert in the facial impression in the proper place while the facial impression is poured. The dental insert is held in place by a clamp, shown in Fig. 483, which

Fig. 485.—Facial cast with iron or wood in position for holding it. (Oliver.)

consists of a steel bow that is threaded, large enough to encircle the outside of the facial impression. A steel cross-bar is used, which carries a central screw, with a slot in each end to receive the steel bow, and which is wide enough to accommodate the posterior width of the facial impression. The dental insert is placed in the facial impression and held in position by the clamp, as shown in Fig. 484. In order that the central set-screw may have a firm grip on the dental insert,

it is well to make a hole in the back side of the dental insert into which a cork can be fitted. This cork gives a more secure hold for the set-screw than the plaster does, which might crumble under pressure and thereby allow the dental insert to become displaced. After the dental insert has been secured in place, the facial impression is filled with soft plaster, care being taken to work it around the dental insert in such a manner as to fill all of the space between the dental insert and the walls of the facial impression. After the first layer

Fig. 486.—Facial cast with wax insert in position. (Oliver.)

of plaster is placed in the facial impression, a second layer is added to give the facial cast the proper thickness and strength. In order to provide some means to hold the facial cast, a piece of iron or strong wood is imbedded in the cast at the time the second layer of plaster is placed in the impression, as shown in Fig. 485. The facial impression is removed from the cast in the same manner as has been described in the other casts. The facial cast with the wax insert in position is shown in Fig. 486. Figs. 478 and 487 show a view of the facial cast with the dental insert in position. The value of the facial

cast with the dental insert is that it gives the relation of the teeth to the face, and the different tooth movements can be observed with regard to the fixed positions of the face.

Some men have objected to the facial cast because of the trouble

Fig. 487.—Front view of facial cast with dental insert in position. (Oliver.)

necessary to make it. This objection is not well founded, for the facial impression can be made in a few minutes and is not a great annoyance to the patient. The facial cast with the dental insert has so many points of superiority over everything else as a matter of record that it is well worth anyone's time to master the necessary technique.

CHAPTER X

USE OF THE X-RAY IN ORTHODONTIA

By James David McCoy, D.D.S.

It is no longer necessary to present an argument in favor of the use of the x-ray in any of the various branches of dentistry, as its merits and possibilities are now recognized by all open-minded and progressive members of the dental profession.

Orthodontists were among the first in the profession to recognize the valuable aid to be gained through the adoption of this agent as a regular part of office routine, and as a result, many of the uncertainties and perplexing situations incident to orthodontic practice have been clarified.

That the orthodontist should maintain his own x-ray laboratory is no longer a debatable point. With it he is able to utilize the x-ray whenever the necessity for its use arises, without subjecting patients or himself to the inconvenience or added expense incident to referring them to a roentgenologist; and what is even more important, *with it conveniently at hand, he will use it whenever indicated, instead of limiting its use to cases of dire necessity.*

It is only logical, therefore, to assume that *an essential part of the preparation of the student or practitioner, who is to undertake orthodontic procedures, will include the basic principles of radiography,* which entails a knowledge of the nature of the x-ray, the electrophysics of its production, the intelligent handling of x-ray apparatus, the technique of radiography, the development of plates and films, the interpretation of radiograms, as well as a knowledge of the dangers arising through the misuse of the x-ray.

Taking it for granted that the reader is thus prepared, it will therefore be unnecessary to discuss here any phases of the above enumerated principles, other than touching upon a few practical suggestions in technique of special significance to the orthodontist.

Owing to the fact that patients undergoing orthodontic treatment are usually children whose ages necessitate their being handled with tact and gentleness if confidence is maintained, precaution should be taken to rid every operation of fear or discomfort. Especially is this essential in making radiograms, for any considerable degree of movement on the

part of a patient will either curtail the value of the finished radiogram, or perhaps render it useless.

The Question of Technique

To obtain a radiogram of any portion of the body, it is necessary to have a photographic or x-ray plate or film (properly prepared so as to exclude all light and moisture) placed in such a position that the x-rays may pass through the desired structures and register their shadows with the least amount of distortion possible upon the plate or film.

In securing radiograms of the dental and oral structures, two general methods of procedure are open to us, each of which has its value and special indications. These are known as the "intra-oral" and "extra-oral" methods.

With the first named, small films are used, which are placed within the mouth opposite the area to be radiographed, and held in position either by means of a film holder, or by the assistant, or better still, by the patient exerting slight pressure with the finger. *This method is indicated when radiograms of small areas only are desired; as, for instance, two or three teeth, with the adjacent alveolar process.*

With the other method of procedure mentioned, namely, the extra-oral method, large plates or films are used, and the areas desired are brought in as close contact as possible with the plate, by pressing or resting the side or portion of the face in which the structures are located against it. The rays are then passed through the structures from the other side of the skull, in such a manner as to cause the shadows of the desired structures to be imposed upon the plate. By using this method, large areas may be radiographed, which in some instances, will embrace the lateral half of both the upper and lower jaws from the region of the lateral incisors anteriorly to the angle of the jaws posteriorly, and from the floor of the orbit above to the inferior margin of the mandible below. In fact, it is possible, by making several exposures, to obtain in detail a radiographic representation of the dental apparatus *in toto,* as well as its associated organs and structures, the nasal cavity, pneumatic sinuses, the maxilla, and mandible.

In selecting a method of procedure for making radiograms of children, the child's comfort must be taken into consideration, and with this idea in mind, the author has found it an advantage to use the extra-oral method quite universally. In fact, he has used it in nearly all cases except where the region embracing the upper anterior teeth is under scrutiny. The wisdom of this course will be apparent to any-

one who has experienced the discomfort of having intra-oral films placed lingually to the mandibular teeth, where the tissues are very sensitive, or has had them placed back in the molar region, against the palate, where they so frequently induce gagging. These unpleasant features are all eliminated by using the extra-oral method, and good radiograms of the structures desired can be secured on the larger plates. This statement should not be construed as a protest against the use of intra-oral films in dental radiography, for it is very often necessary to use such films with adult patients where a high degree of detail is essential in

Fig. 488.—The arrangement of the apparatus preparatory to seating the patient. (McCoy.)

determining the condition about non-vital teeth, root canal fillings, etc. In orthodontic practice, however, where we are dealing with young subjects entirely, a sufficient degree of detail can be obtained in the majority of instances, using the extra-oral method to satisfy the needs of the operator.

Seating the Patient

In preparing the patient to be radiographed, it is important that a suitable chair be provided, which will afford ample support, not only for the head, but will make it possible for the patient to be sufficiently

Fig. 489.—Position of patient's head for extra-oral exposure. (McCoy.)

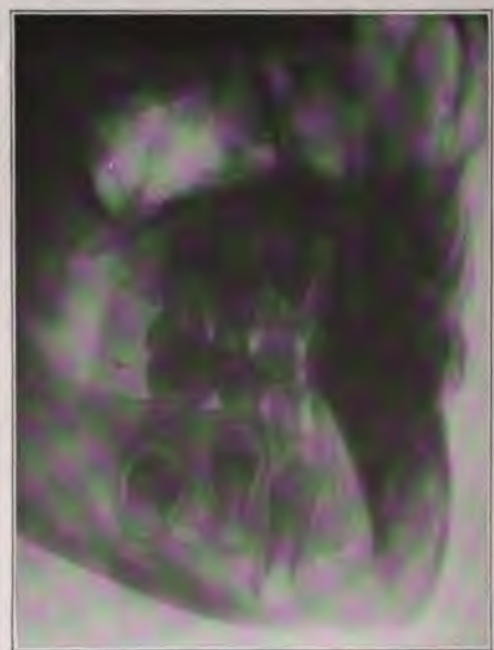


Fig. 490.—Radiogram obtained from position shown in Fig. 489. (McCoy.)

Fig. 491.—Position of patient's head for extra-oral exposure. (McCoy.)

Fig. 492.—Radiogram obtained from extra-oral exposure to determine presence of permanent teeth. (McCoy.)

comfortable to remain quiet, without difficulty. For this purpose, the dental chair may be used, or if this is not convenient to the x-ray apparatus, the ordinary armchair with a headrest may be utilized. The author has found it an advantage to use the ordinary chair with a straight back and small arms, placed against the back of the dental chair (Fig. 488). The headrest of the dental chair is turned over and adjusted to the proper height, position and angle to support the patient's head. If the extra-oral method is being utilized, the headrest wings are flattened out to make a resting place for the plate. In this way, the patient's head is afforded the firm support of the heavy dental chair, and

Fig. 493.—Position of patient's head for intra-oral exposure of incisors. (McCoy.)

the plate is held in an immobile state without difficulty and the operator can, by making a few changes in the position of the small chair, and by moving and readjusting the headrest, have radiographic access to any part of the dental structures (Figs. 489 to 493). The fact that this requires but a few moments, does not disarrange the office, or put the patient to discomfort, justifies the author in feeling that it is an excellent method for use in the dental office. Of course, it is necessary where this method is followed, to have the x-ray machine and accessory apparatus in the same room with the dental chair. Where this is not possible, it is an easy matter to attach an adjustable headrest to the ordinary straight-back chair, and by having the patient change positions in the chair, accomplish the same result.

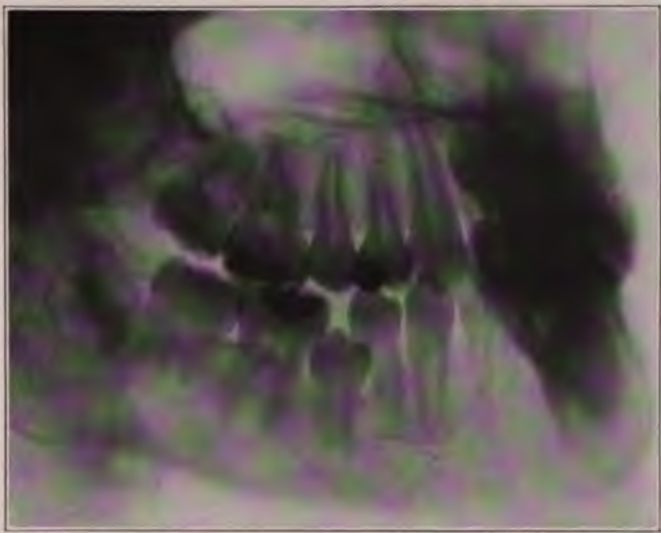


Fig. 494.—Radiogram to show space necessary for impacted premolar. (McCoy.)

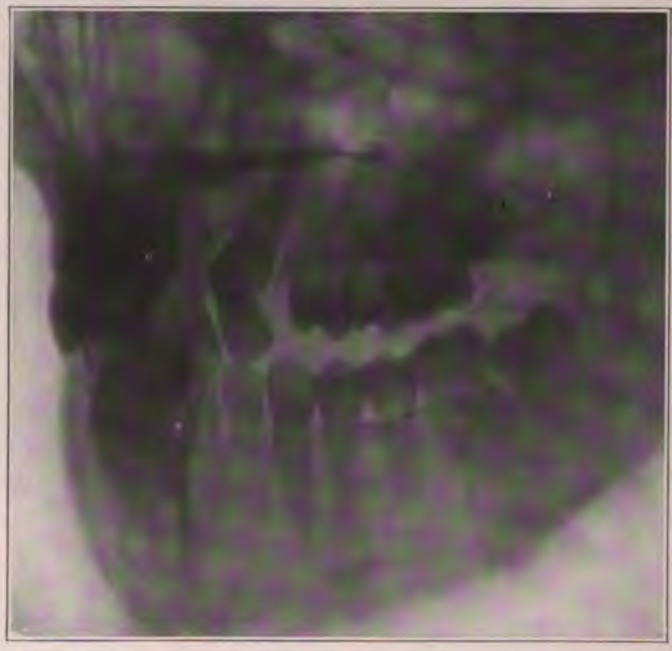


Fig. 495.—Radiogram to show space necessary for impacted canine. (McCoy.)

Indications for the Use of the X-ray by the Orthodontist

The necessity for using the x-ray in orthodontic practice, varies with different patients, but generally speaking, may be summarized under ten different headings as follows:

1. *As a means of determining the presence or absence of unerupted permanent teeth before treatment is started.*

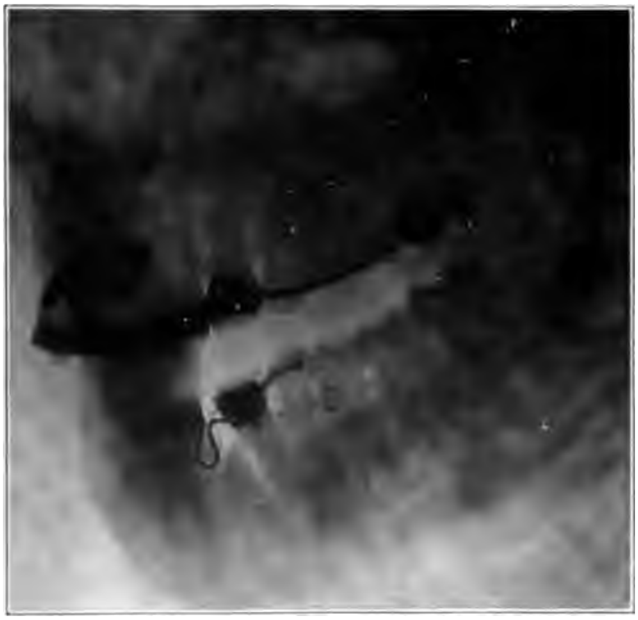


Fig. 496.—Radiogram to show space necessary for impacted tooth. (McCoy.)

The majority of patients requiring orthodontic treatment usually have a mixed dentition; that is, they usually have present in the mouth, the deciduous molars and cuspids. It is essential, therefore, to determine whether or not these deciduous teeth all have permanent successors. If the upper and lower incisors have erupted, information concerning the other permanent teeth is easily obtained, by making a radiogram of each side by the extra-oral method. Such radiograms are shown in Figs. 490 and 492.

Such radiograms give the operator a very adequate survey of these unerupted teeth, and leave no doubt as to their presence or absence.

2. *As a means of determining the approximate size of unerupted teeth, for which space must be made in the arches.*

Where the deciduous molars or cuspids have been lost prematurely, with the usual resultant loss of space in the arch involved, the radiogram can be made to show quite accurately the amount of space which it will be necessary to establish, if adequate space is to be prepared for the unerupted teeth (Figs. 494, 495, and 496).

Fig. 497.—Radiogram showing condition of unerupted second molar. (McCoy.)

3. *To determine the state of development of unerupted teeth which are tardy in their eruption.*

Not infrequently permanent teeth fail to come through when expected. By utilizing the radiogram their degree of development is easily determined, and often the cause for their noneruption is determined. Steps can then be taken to open up spaces, and hold them until such a time as the teeth involved progress in their development to the point of eruption (Fig. 497).

4. *To determine the approximate direction in which teeth are erupting, and the relationship which they will have to the line of occlusion when erupted.*

Where the deciduous teeth have been retained in the mouth longer than their normal period, and where the roots of these teeth have not been entirely absorbed, the erupting permanent teeth will sometimes be deflected

Fig. 498.—Radiogram to show direction of erupting teeth. (McCoy.)

Fig. 499.—Radiogram to show location of canine to aid in making attachment. (McCoy.)

Fig. 500.—Radiogram to show location of lateral incisors and anomalous teeth. (McCoy.)

Fig. 501.—Same as Fig. 500 with attachment on lateral incisor. (McCoy.)

out of their normal course. It is an advantage to know the direction in which they are deflected, so that if retaining appliances are to be placed, they may be arranged in such a way, and in such a relationship to the erupting teeth that they will not interfere with them. In fact, it is sometimes possible to construct the retainer in such a way that the tooth which is deflected out of its course may be guided towards its normal position,

Fig. 502.—Radiogram to show conditions in tardy loss of deciduous tooth. (McCoy.)

Fig. 503.—Unerupted upper second bicuspid retarded in its eruption by the presence of the deciduous second molar. (McCoy.)

or moved there before the inclined planes of the opposing teeth become a factor in establishing it entirely out of its normal position (Fig. 498).

5. *As a guide where it is necessary to make attachments to unerupted teeth, to aid in their eruption.*

While it is not often necessary to secure attachments to teeth lying beneath the gingival tissues, the occasion for this sometimes arises, as shown

Fig. 504.—Radiogram showing relation of incisor roots to canine. (McCoy.)

Fig. 505.—Radiogram showing relation of canines to centrals. (McCoy.)

Fig. 506.—Radiogram showing relation of permanent canine. (McCoy.)

Fig. 507. Radiogram showing position of canine root. (McCoy.)

in Figs. 499, 500, and 501. In such cases, radiograms should be made as a guide in securing the attachment. After the attachment is secured, others should be made to determine the direction in which force should be applied to accomplish the desired tooth movement.

6. *To determine the most opportune time for the extraction of the deciduous teeth.*

Where the deciduous tooth persists in the mouth, and shows no sign of being shed, it is an advantage to determine the extent of absorption of the roots, as well as the development of its successor, so that if extraction is resorted to, it can be done with the knowledge that the developing tooth will not be disturbed or injured, and that the successor has reached a degree of development which will insure its eruption within a reasonable time (Figs. 502 and 503).

Fig. 508.—Radiogram showing location of erupting lower third molars. (McCoy.)

7. *To observe the movement of the roots of teeth and their relationship to other roots and structures.*

In the bodily movement of teeth, and particularly of the incisors, it is important in young subjects that these roots do not encroach upon each other or upon other teeth; for instance, an unerupted cuspid. It is, therefore, advisable, where any doubt exists, to determine the exact status of this relationship (Figs. 504 to 512).

8. *To determine the relationship of developing third molars to certain recurrent malocclusions, and also as a precaution so that steps may be taken to prevent these teeth from becoming a cause of malocclusion during their eruption.*

The pressure exerted by developing lower third molars is often sufficiently great to cause a crowding of the lower incisors and cuspids (Figs. 508 and 509). This can be true, even though malocclusion has not existed in this region previous to the development of the third molars. By

Fig. 509.—Radiogram showing position of lower third molars. (McCoy.)

making radiograms from time to time, of those patients who are of an age for development and erupting these teeth, the status of the developing teeth can be determined and the necessary precautions taken to prevent the crowding of the incisors and cuspids.

9. *To observe non-vital teeth prior to tooth movement, to determine their fitness for movement or anchorage, and their state of health during the process of orthodontic treatment.*

Where it is necessary to either move non-vital teeth, or utilize them as anchorage, it is essential to the patient's welfare and comfort to know that such teeth and their investing tissues are in a healthy condition. By determining this prior to instituting orthodontic treatment, much trouble both to the patient and operator can often be avoided (Fig. 510).

10. *In cases where anomalous teeth are present, to differentiate between anomalous and normal teeth.*

Fig. 510.—Radiogram to show condition of mandibular molar which is used for anchorage. (McCoy.)

Fig. 511.—Radiogram showing anomalous tooth. (McCoy.)

Fig. 512.—Radiogram showing absence of mandibular centrals. (McCoy.)

In a majority of instances, this can be done without the aid of the radiogram, unless the teeth in question have failed to erupt. Under such conditions, by utilizing accuracy in the technique of making the radiograms, little difficulty is encountered in determining the difference between normal and anomalous teeth. (Examples are shown in Figs. 500, 511 and 512.)

CHAPTER XI

TREATMENT OF CASES

Neutroclusion, or Class I

Cases of neutroclusion, or Class I, present many different features. They resemble each other in that they have a normal mesio-distal relation of the arches. In other respects they may differ a great deal, as shown by the different types that were described under classification.

Taking up the treatment of the simpler malocclusions of this class first, we shall consider the treatment of such cases as are shown in Fig.

Fig. 513.—Neutroclusion, or Class I, case. Lingual occlusion of maxillary incisors to mandibular.

513. In this case, the arches are in normal mesio-distal relation. The upper incisors are in lingual relation to the lower. In fact, the upper teeth are lingual to their proper position and the lower incisors are labial. The patient is five and one-half years old. If the malocclusion is not corrected, it is certain that the permanent teeth will take the same position as shown by the deciduous teeth. The demand for treatment at this age is obvious. If this condition was allowed to exist until the eruption of the permanent teeth, the malocclusion would probably develop into a mesioclusion, or Class III, case.

The appliance used in the treatment of the case shown in Fig. 513 could not be improved upon so far as efficiency was concerned, the only objection being that of conspicuousness of the appliance on the maxillary teeth. In order to have an appliance that would be inconspicuous on the maxillary teeth, it would be possible to use a lingual wire soldered to bands on the second deciduous molars. The incisors

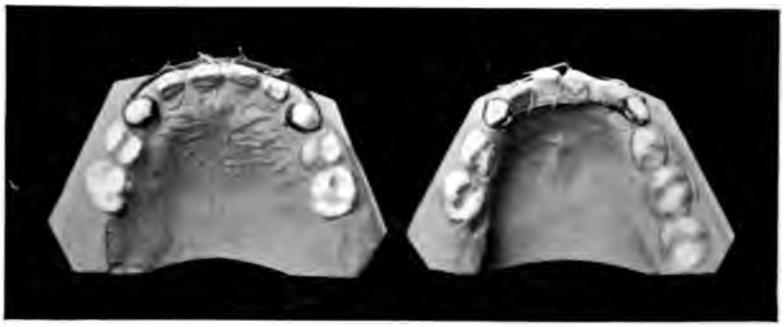


Fig. 514.—Appliance for moving maxillary incisors labially and mandibular incisors lingually.

Fig. 515.—Completed case of Fig. 514.

would be carried forward by pinching the lingual wire in the premolar region as illustrated by Fig. 257. This gives an appliance on the upper teeth that cannot be seen at all.

Plain bands, made as described in Chapter V, were placed on the upper and lower canines. On the upper bands, a wire was soldered on the labial side, far enough labially to permit the incisors to be brought

labially to their proper position. On the lingual side of the lower canines a wire was soldered, far enough lingually to permit the lower teeth to be moved lingually. The appliances are shown in Fig. 514.

Fig. 516.

Fig. 517.

Figs. 516 and 517.—Side and front views of neutroclusion, or Class I, case.

The upper and lower teeth were tied to the respective appliances by silk ligatures that exerted force on the teeth. In a few weeks the teeth were in the position shown in Fig. 515 and were retained for a short

time by fastening them to the appliance by means of wire ligatures, which exerted a passive force.

Figs. 516, 517, and 518 show a case of neutroclusion, or Class I, the upper central incisors and right lateral incisor being in linguoversion. The left lateral incisor is in torsiversion. The lower incisors are slightly in labioversion. A space exists between the lower left lateral and canine, which shows the distance the lower anterior teeth are mesial. After studying the case carefully, the author came to the conclusion that the position of the mandibular teeth was the result of the malocclusion with the upper, and if the maxillary incisors were moved labial to the mandibular, the force of the maxillary teeth

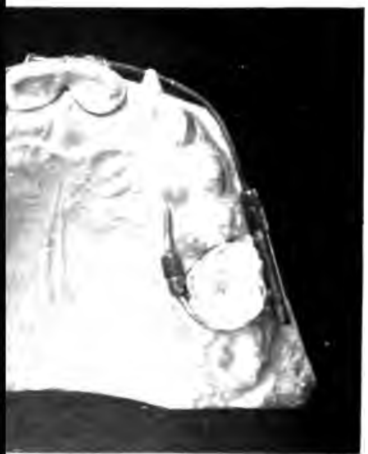
Fig. 518.—Black line indicates position expansion arch should occupy to the upper teeth and gingival margin.

against the mandibular teeth would force the mandibular incisors lingually to their proper position.

The maxillary teeth were treated by placing clamp bands on the first molars. The screw was so placed that it occupied the position shown in Fig. 520, which also shows the position of the tube on the molar band. The arch was bent and adjusted so as to stand away from the anterior teeth, as they are the only ones that have to be moved. On the maxillary left lateral incisor, a plain band was placed with a spur soldered near the disto-gingivo-lingual angle. The position of the arch is shown in Figs. 519 and 520. Wire ligatures were then placed on the upper anterior teeth and twisted tightly. At first, the greatest force was placed on the central incisors so as to avoid too much pressure on the

sors started to move, force was placed
he teeth had started to move, the three
l, were carried labially by tightening

h premolar region. Band on left canine to
the same.



lateral but is not shown.

laterals screwing the nuts distally.
mesial was tightened at each
rsion of the lateral, on which was

placed a plain band with a spur. After the maxillary teeth were moved into the position shown in Fig. 521, the teeth were retained by passive retention, as shown in Fig. 522. The retaining appliance was

Fig. 521.

Fig. 522.—Showing retention of Fig. 518.

worn until the maxillary canine erupted, for it was necessary to retain the space for the permanent canine as the deciduous canine was soon lost. The occlusion of the upper incisors with the lower teeth carried the lowers distally and closed the space between the lateral

3. This case was one belonging to the

ıtroclusion with linguoversion of the
nderdeveloped condition of the max-
Plain bands were placed on the first
l wires were soldered to the lingual
ıde for 19-gauge iridio-platinum. By
th the wire-stretching pliers, expan-
ıes. The labial movement of the left
l by a finger spring soldered to the
. 525. By springing the maxillary

ote how occlusion has driven lower anterior teeth
between canine and premolar.

ossible to so adjust the finger spring
cisor assume a position shown in Fig.

the molars at the beginning of treat-
maxillary deciduous molars, the per-
mal position in the maxillary arch.
rs were retained, which held the first
the beginning of the treatment the
sed as an anchor tooth carrying the
e right permanent molar from moving
l and canine portion of the mandib-

ular arch was corrected the lingual appliance was changed by removing the band from the right mandibular molar, and using a lingual wire extending from the left molar to the right second incisor as a retaining appliance. This appliance left the right molar free to move forward as can be seen in Fig. 528. In using a form of appliance care should be exercised to select such teeth as anchorage,

Fig. 524.

Fig. 525.

Fig. 526.

Fig. 527.

as can be used without interfering with the natural development of the arches.

Fig. 529 shows another case of neutroclusion, or Class I, that is typical of a great many cases belonging to this class and is one of the first type. In order to treat this case, it will be necessary to expand both the upper and the lower arch. The upper arch is underdeveloped

about equally on both sides, and therefore the teeth will all have to be moved equally with the exception of the upper canines, which will have to be depressed slightly. The front view (Fig. 529) shows that the median line of the upper and lower incisors is not a straight line.

Fig. 528.

Fig. 529.—Neutroclusion, or Class I, case. Normal mesio-distal relation of arches.

This is caused by the fact that the lower incisors have drifted to the right. The right lateral is distal to the canines and all of the lower incisors will have to be moved to the left.

Ligature wires are twisted between the teeth, as described in Chapter V, so as to produce enough separation to permit putting on the molar bands. Clamp bands are placed on the upper and lower first molars, as shown in Figs. 530 and 531. Plain bands could have been

Fig. 530.

Fig. 531.

Figs. 530 and 531.—Occlusal view of appliances. Spurs on lower arch to move teeth toward left side.

used on this case as satisfactorily as clamp bands. The upper arch is adjusted in such a manner that it stands away from the second premolars slightly and a little farther away from the first premolars.

A bend is made in the canine region so that the arch lies below the tip of the canine. No effort is made to place the arch labially to the maxillary canines, for it would be too prominent and hold the lip out too far. The arch stands labially to the incisors, as shown in Fig. 530. In order to exert force on the upper canines to depress them, tube-spurs are soldered to the arch, as shown in Fig. 532. These spurs are bent to fit the labial convexity of the canine and by bending the spur with a pair of pliers, force is exerted on the canines to depress them. This pressure can be increased by putting a rubber wedge between the canine and wire spur. The molar bands are placed on the mandibular first molars and the arches adjusted, as shown in Fig. 530. Fig. 531 shows the shape of the lower alignment wire. The lower alignment wire is bent so as to assume a position labially to the lower

Fig. 532.—Front view, showing spurs to depress canines.

right canine and bent with rather a sharp angle in the canine region. Owing to the fact that the mandibular incisor must be shifted to the left, soft solder wire spurs are placed on the arch at points shown in Fig. 532 and the ligatures placed so as to pull the teeth to the left. In order to increase the pull of the teeth toward the left side, the expansion arch, or alignment wire, is so adjusted that it stands away from the left canine region farther on the left side than it does on the right.

The maxillary teeth were retained by placing bands on the maxillary lateral incisors and the first molars. The first molar bands are plain

bands. A lingual wire was placed on the lingual side of the teeth to retain the expansion of the arch. A spur was soldered on the labial side of the lateral incisor to make a downward pressure on the canine.

Fig. 533.

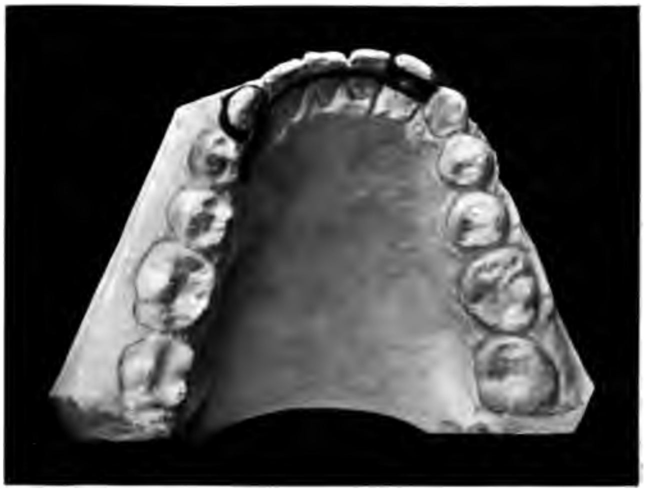


Fig. 534.

Figs. 533 and 534. Occlusal view of retainers. Compound reciprocal intermaxillary retention.

The occlusal view of the retainer is shown in Figs. 533 and 534. The lower arch was retained by plain bands on the molars, left canine and right lateral. A lingual wire was used to retain the expansion of the

teeth. A spur was soldered on the labial surface of the right lower lateral band to retain the canine. No band was placed on the lower right canine, for it was in infra-occlusion, and a band would have prevented it from elongating as it should. The front view of the retainer, which is a compound reciprocal retainer, is shown in Fig. 535.

Figs. 536 and 537 show a case of neutroclusion, or Class I, in which there is bunching of the maxillary and mandibular teeth. The front view of the case shows that the median line of the maxillary and mandibular teeth is not in balance. The maxillary teeth have drifted to the right and the mandibular teeth to the left. The occlusal view (Figs. 538, 539 and 540) shows the reason for the shifting of the me-

Fig. 535.—Front view of retaining appliance. Spurs to hold and move maxillary canines occlusally.

dian line. The position of the maxillary and mandibular canines is due to the early loss of the deciduous canines, which permitted the maxillary anterior teeth to drift to the right and the mandibular anterior teeth to the left. When the mandibular left canine erupted, it forced the lateral incisor lingually and took a labial position. After separating the molar teeth, clamp bands were placed on both the maxillary and the mandibular first molars. The arches were bent in the canine region to give the relations shown in Figs. 538, 539 and 540. Owing to the infraversion of the right maxillary canine, it was necessary to place a tube spur on the arch, as shown in Fig. 541. It will be noticed that the spur is double, one part of which projects gingivally and distally and rests on the labial surface of the canine and the

other part projects occlusally and distally and is used for intermaxillary anchorage. In adjusting the upper arch it is made to stand away from the canine and lateral on the right side, and spurs are soldered

Fig. 536.

Fig. 537.

Figs. 536 and 537.—Neutroclusion, or Class I, case. Largely due to early loss of deciduous teeth.

Fig. 538.—Occlusal view, showing spurs on arch and bend in arch on right side to move median line to the right. Dotted line shows position of arch before being placed in tube.

Fig. 539. Shows how ligatures spring arch toward teeth. Dotted line represents position of arch before ligatures were placed on teeth.

on the expansion arch in the position shown in Fig. 542. When the ligatures are placed on the anterior teeth, the arch will be sprung as shown by the dotted lines. It will now be seen that the placing of the wire ligatures, as shown by the lines, has pulled the upper arch to the right side. No ligature should be placed on the left lateral incisor until the other three incisors have been moved to the right far enough to give room to bring it through. In applying the wire ligatures on the incisors, the right lateral should be ligated first as it is the one that receives the greatest stress; if the centrals were ligated first and the lateral last, it would be found that the ligatures on the centrals were

Fig. 540.—Shows relation of lower arch to teeth. Ligatures and spurs on lower arch to move teeth to left.

loose after the lateral was ligated. After the three incisors have begun to move, a wire can be placed on the left lateral and the gingival part of the tube-spur bent down on the canine.

The lower expansion arch is applied the same as the upper arch except that the spring is reversed; that is, the left side of the arch takes its position away from the canine region and the spurs are soldered to the arch at the left side of the teeth that are to be moved. The position of the spurs can be seen by noting Figs. 540 and 541. On the right side of the lower arch is soldered a sheath-hook for the use of intermaxillary anchorage. The left canine, left lateral incisor and the centrals are ligated to the arch, which causes the arch to assume the position shown by the dotted lines. From the sheath-hook on the lower arch

Gingival spur to depress canine. O
ary rubber, as shown in Fig. 542.

nt re-lifting median line of upper and

to the sheath-hook on the upper arch, an intermaxillary rubber is stretched and worn at night, which assists in shifting the median line. This use of the intermaxillary anchorage was first described to the author by Angle.

As a result of the treatment, the teeth were brought to their proper position and the median line of the upper and lower arches corrected, as shown in Fig. 543. The retention of the upper arch consisted of a plain band, which was placed on the left lateral with a spur on the lingual side that engaged the lingual side of the left central, and a spur on the mesial side of the lateral band bearing against the labial

Fig. 543.—Completed case.

surface of the canine, gingivally to the greatest convexity; so by bending the spur downward, pressure would be brought to bear on the canine that would cause it to assume the proper position in the arch, as it is in infra-occlusion. Owing to the length of the cusps, it was impossible for the upper arch to change unless the left canine and lateral slipped out of the line and the mandibular teeth changed. Therefore, it was important that the lower arch be retained in order to make the upper stay. Bands were placed on the lower canine and the right lateral incisor. A wire was soldered to the lingual surfaces con-

necting the two bands. On the labial side of the lateral band was soldered a spur, which engaged the labial surface of the right canine that had been moved from labioversion and was still in infraversion. A band intended for use in compound retention should never be placed

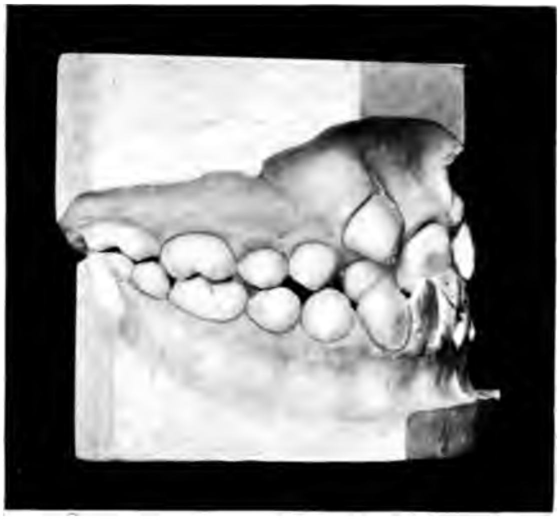


Fig. 544.

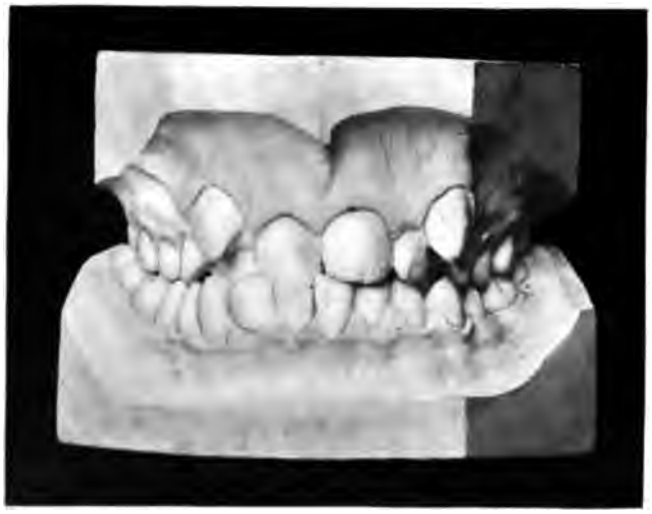


Fig. 545.

Figs. 544 and 545.—Neutroclusion, or Class I, case. Notice extreme linguoversion of maxillary lateral incisors.

on a tooth that is in infraversion, for it prevents the tooth from taking its proper position in the arch.

In removing the retaining appliances from a case of this kind, the

Fig. 546.—Upper appliance ligated to teeth.

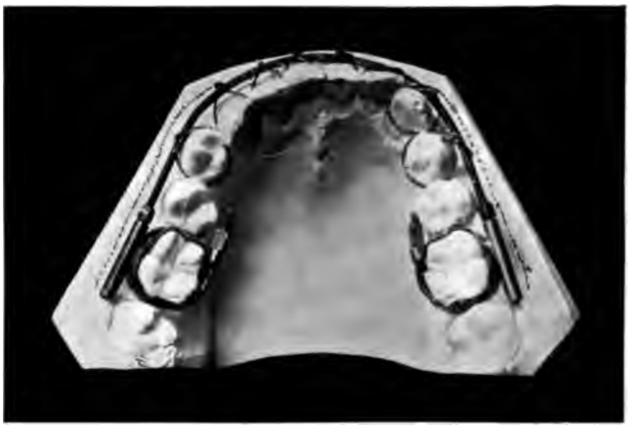


Fig. 547.—Dotted line on lower shows relation of heels of arch to tubes before arch is placed in molar bands.

upper should be removed first and the lower left a month or more longer. In any case, all of the retaining appliances should not be removed until all of the forces of occlusion have been established.

The right and front view of the case illustrated in Figs. 544 and 545 shows it to be one of neutroclusion, or Class I, as the arches are in normal mesio-distal relation. By looking at the right side and the front view it will be seen that the right lateral and central are in lingual occlusion. The occlusal view shows the right lateral in contact with the premolar. The entire upper arch needs to be expanded. Ligature wires were placed on the mesial and distal sides of the first molars and twisted to separate the teeth slightly so as to permit the placing of the molar bands. The molar bands were so placed that the tube lined buccally to the canine. While the canines are prominent, as the teeth now stand there is not sufficient room between them to accommodate the incisors. One side of the arch was placed in the tube on the molar band so as to obtain the proper length and alignment.

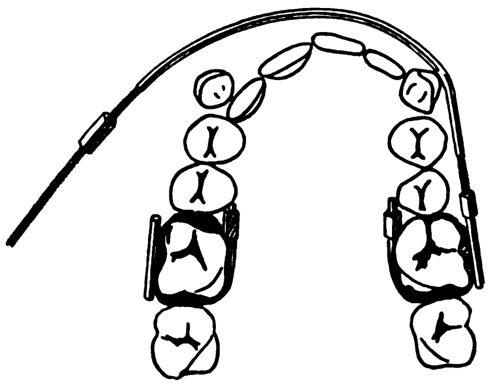


Fig. 548.—Showing method of adjusting arch by beginning at one side and carefully adjusting same until molar on opposite side is reached.

The arch is allowed to stand away from the premolars and canine. In the region of the canine, the arch is bent at an angle, as shown in Fig. 548. This bend is made in one side only, and the arch is in one tube only at this time. The position of the anterior part of the arch to the anterior teeth is now noted, and the arch bent again in the region of the canine on the opposite side. The buccal part of the arch is now aligned with the tube. Up to this time, the arch has been placed in the tube on one side only. With the side of the arch in the tube that was first adjusted, the position of the other side is carefully noted. It should be observed how the angle of the arch compares with the angle of the tube before being placed in the tube. The arch should also stand buccally to the tube, for the molars require expanding and a slight amount of expansive force should now

buccally to the tube the width of a 16-gauge wire and will not exert enough expansive force to cause any pain. In adjusting the wire so as to produce expansion, the spring that produces the expansion be given the arch. The arch or alignment wire can be made to stand

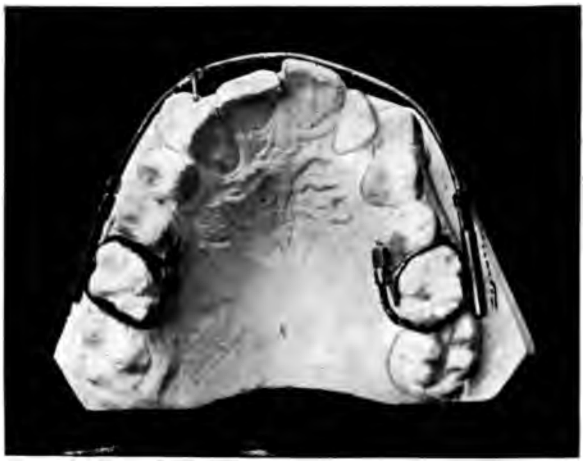


Fig. 549.—Plain bands with spurs were placed on the laterals, but are not shown on this model. Upper arch does not touch canines as those teeth must be expanded. Spur opposite right lateral is for bodily movement of same.

Fig. 550.—Front view of appliances. Right maxillary lateral incisor is ligated to arch after sufficient room has been made to allow it to move.

must be derived from the anterior segment of the wire, and never from the heels or the distal corners, or the molars will rotate buccally. The position of the adjusted arch to the teeth is shown in Figs. 549 and 550. The positions of the ends of the arch to the tubes before they are placed in the tubes are shown by the dotted lines. Bands are placed on the laterals with spurs so that they can be rotated and also to prevent the ligatures from slipping off. A spur is soldered on the arch at a point directly labially to the mesial surface of the right lateral, as the tooth must be moved directly labially in order to get past the canine. After the premolars have been expanded slightly and the incisors moved labially, it will be necessary to place a tube-spur on the upper arch so as to move the apex of the right lateral forward. This spur rests

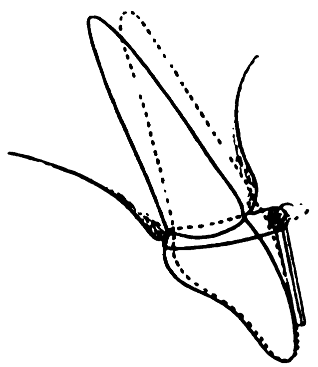


Fig. 551.—Cross section of arch and spur for bodily movement of teeth shown in Figs. 549 and 550.

against the incisal edge of the tooth, which prevents that part from moving, and by tightening the ligature the apex is brought forward. The position of the spur is shown in Figs. 549, 550, and 551.

There is nothing unusual or new in the adjusting of the lower arch as the teeth need expanding slightly. The left lower canine must be banded so as to permit its rotation.

The teeth of the upper and lower arch, having been expanded, are retained by compound reciprocal retention, so as to permit them to respond to the forces of occlusion. Bands are placed on the upper lateral incisors. A spur, long enough to engage the lingual surface of the central incisor, is soldered on the lingual side of each band. A long spur, extending back to the mesial portion of the upper first molar, is soldered on the labial surface of the lateral band. This long spur rests

against the upper canine on the labial surface. Ligature wires, which have had a piece soldered to them as shown in Fig. 552, to prevent their slipping under the gum, are placed on the first and second premolars.

Fig. 552.

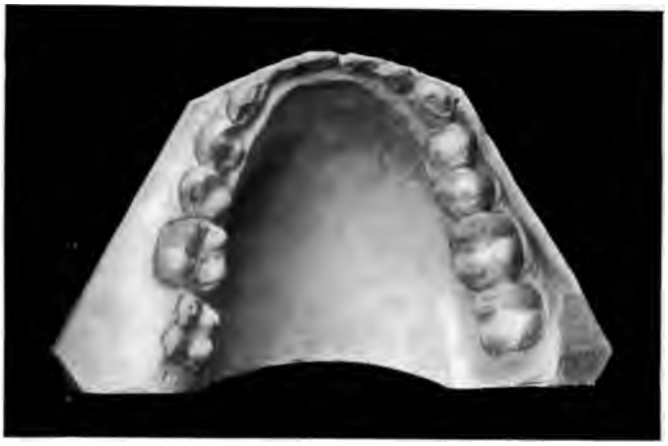


Fig. 553.

Figs. 552 and 553. Impressions made after retaining appliances were placed on teeth.

This plan of soldering a wire on the ligature wire to prevent it from slipping under the gum was suggested to the author by Lourie. After the premolars have been ligated to the labial spur we have the

retaining appliance, as shown in Fig. 554. The advantage of this form of retainer is that none of the teeth are held rigid, and by bending the spurs different amounts of force can be brought to bear on different teeth. The greatest tendency for the teeth to return to their former position is in the region of the first premolar, canine and lateral. This tendency is prevented by the use of the retaining appliance, which has been so constructed as to make possible the highest degree of compound active reciprocal retention. The lower teeth were retained by the device shown in Fig. 553.

Fig. 554.—Front view, showing long labial spur over canine.

Fig. 555 shows the occlusal view of a model before and after treatment, in which it was necessary to expand the upper arch as well as the lower arch, but the particularly interesting thing in the treatment of this case was the manner in which the maxillary lateral incisors were moved bodily. The appliance used in this case consisted of a high labial arch the position of which can be seen in Figs. 556 and 557. This appliance as used by Lourie on this case, consisted of plain bands upon the molars, the buccal tubes to receive a 17-gauge gold and platinum straight alignment wire. This alignment wire mesial to the buccal tubes on the nut on the alignment wire is bent gingivally so as to make the anterior portion of alignment wire occupy position above the gingival line of the tooth. The object of this is to make the appliance less conspicuous as well as to make possible the use of a long finger spring with a recurved extension, as can be seen by

studying Figs. 556 and 557. This recurved spring extension is made of 24-gauge gold and platinum spring wire or of 22-gauge gold spring wire which is tapered down at a point occlusal to the solder attachment to the heavy alignment wire until it is the size of the 24-gauge wire, the short end of which goes into a 24-gauge tube. It has been found by practice and experience that the elasticity in a 24-gauge wire is sufficiently strong to produce an apical movement of the tooth and not sufficiently strong to produce any amount of pain or soreness in the tooth as it is being corrected. The advantage of the high labial wire is first, inconspicuousness, and second from a mechanical standpoint, it has the advantage of the use of a long spring which gives a greater amount of elasticity than is found in any other method for bodily or apical tooth movement. On the left central incisor it will be observed that there is a finger spring resting against the labial surface, which was for the purpose of depressing that tooth. The appliance was first adjusted so that it could act directly upon the lateral incisor, which has bands carrying a perpendicular tube for the purpose of receiving a short end of the J wire. By having this finger extension on the lateral incisor made in the form of a J, it is possible to control any torsiversion which is present in the teeth, as can be observed by studying Fig. 560. After the maxillary teeth had been expanded and moved to the proper position, the canines then erupted, and it was found necessary to place bands on the canine carrying a short spur or lug which received a long spring extension soldered to the labial alignment wire, and which can be observed by studying Figs. 556 and 557. This spring extension resting upon the canine lug would assist in its eruption and correct the torsiversion which is shown in the illustration. In Fig. 561 it will be noticed that the end of the spring extension which rests over the lug on the canine band is bent in the form of a curve and that the curve portion of the spring extension rests upon the lug on the canine. As this spring extension exerts considerable pressure on the lug on the canine band the curved end of the spring extension also exerts a distal action which is sufficient to carry the canine distally to its proper position. The use of the high labial arch with the recurve spring extension as shown in Figs. 555, 556, and 557 makes one of the most efficient methods for apical tooth movement and also for the correction of torsiversion that the author has ever used.

The case illustrated by Fig. 558 has a normal mesio-distal relation of the arches on both sides. The maxillary teeth on the right side, from the central to second molars, are in lingual occlusion, except

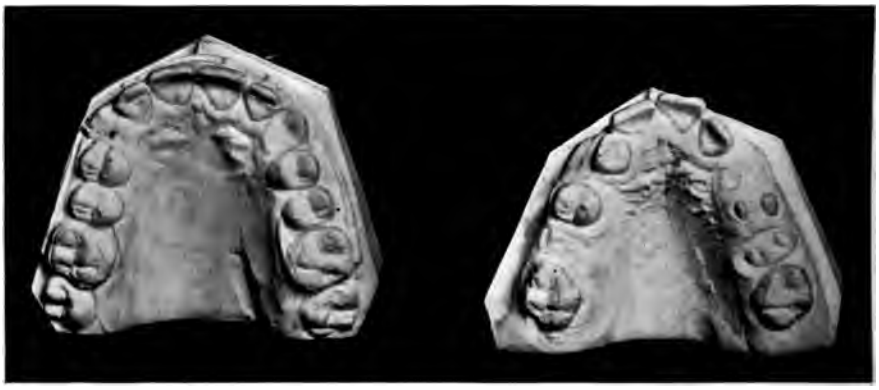


Fig. 555. (After Lourie.)

Fig. 556. (After Lourie.)

Fig. 557. (After Lourie.)

the canine. This makes it necessary to expand or move the maxillary teeth on the right side farther than we shall move the same teeth on the left side. It will therefore be impossible to use reciprocal anchorage, which has to a certain extent been employed in the former cases. In order to move the teeth that are in lingual occlusion to their proper position, we have the choice of several methods and anchorages. We can use reënforced simple anchorage, stationary anchorage, or intermaxillary anchorage.

In using reënforced simple anchorage, the molar bands are adjusted to the first molars in the usual manner. The arch is placed in the tubes

Fig. 558.—Neutroclusion, or Class I, case. Maxillary molars and premolars on right side in linguoversion to mandibular.

on the molar bands with expansion in the molar regions. If nothing else was now done, there would be an equal amount of force exerted on the molars of both sides, which is not desired. However, in order that the molar on the left side may have the advantage over the one on the right side, the screw on the left molar band is bent against the premolar, as in Figs. 559 and 560, and away from the premolar on the right side. This enlists two teeth on the left side against one on the right side. To further increase the anchorage on the left side, the first premolar and canine are ligated to the arch. This now makes reënforced simple anchorage, as a number of teeth on the left side are pitted against the tooth on the right side. Owing to the attachment

of the peridental membrane and the alveolar process, it will be impossible to move the right first molar without exerting some force on the second molar and second premolar. In fact, when expanding the

Fig. 559.—Showing arch before it is placed in tube.

Fig. 560. Showing arch after having been placed in tubes.

first molar in cases of this kind, it is seldom necessary to attach to the second molar. In order to increase the buccal movement of the right molar, intermaxillary anchorage can be used by placing a rub-

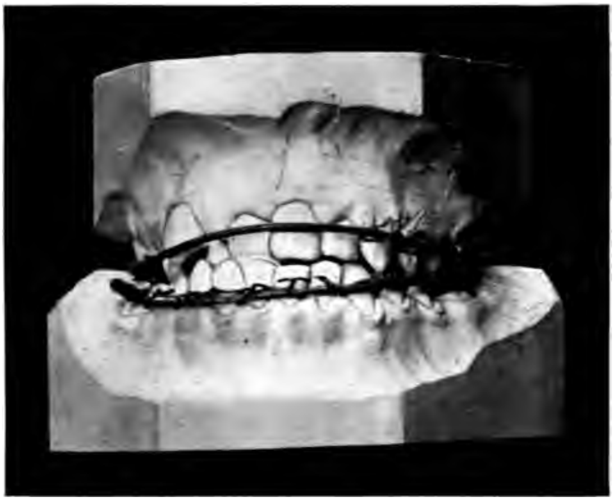


Fig. 561.—Front view of arches in position.

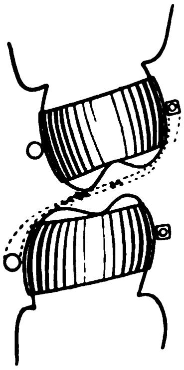


Fig. 562.

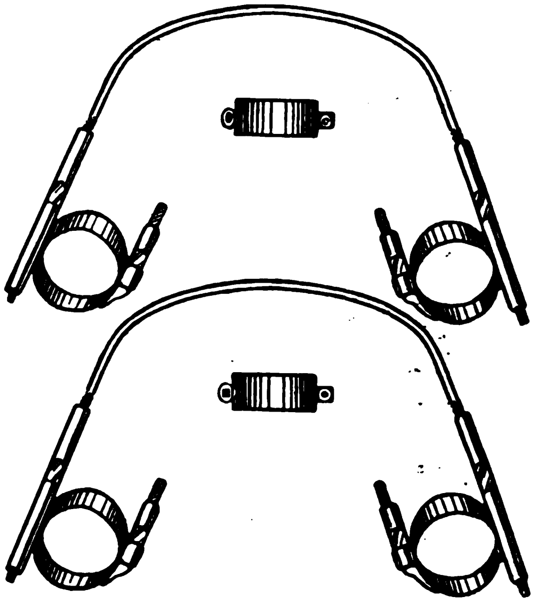


Fig. 563.

Fig. 562.—Rubber ligature from screw on lingual side of right maxillary molar band to tube on right mandibular molar band.

Fig. 563.—Showing oval and square tubes for stationary anchorage of molars.

ber ligature from the screw on the lingual side of the right upper molar band to the tube on the right lower molar band. This will make the rubber occupy the relation as shown in Fig. 562. If rubber ligatures of good quality are used, they will resist the stress of mastication remarkably well.

Fig. 564.

Fig. 565.

Figs. 564 and 565. Front and occlusal view of Fig. 558, showing retention.

It has been stated that the molars and premolars on the right side could be moved by stationary anchorage. Stationary anchorage can be produced in several ways. One way is to use an oval tube; the arch is also oval, which prevents the arch from turning in the tube (Fig. 563). This oval tube is used on the left side or the side that is to be made stationary. A square tube serving the same purpose has been

devised by Kemple. If the oval or square tube cannot be obtained, stationary anchorage can be produced by the use of the ordinary round tube and expansion arch in the following manner. The arch is adjusted to the teeth and bent to align with the tube as it should. On the left side the tube is pinched to the arch by means of heavy pliers or a wire cutter. Then the nut on the band is loosened and the band removed with the arch in the tube. The tube is then soldered to the arch by means of soft solder. Soldering the arch in the tube makes the tipping of the left molar impossible unless the arch bends. The bending of the arch must be taken into consideration in any of the forms of anchorage that we have mentioned. Care must be exercised so as not to strain the anchor tooth.

Another means of producing greater resistance on one side of the dental arch than we have on the other is to employ a perpendicular

Fig. 566.—Perpendicular tube to produce stationary anchorage on molar in unilateral buccal expansion.

Fig. 567.—Parallel tube to allow tipping of molar in unilateral buccal expansion.

tube on one side, as shown in Fig. 566 and a horizontal tube, as shown in Fig. 567. The perpendicular tube prevents the molar from moving unless it is carried bodily, and the horizontal tube allows tipping of the molar.

After the upper arch was expanded to the proper size, and the teeth on the right side brought to their proper position, they were retained by the retention as shown in Figs. 564 and 565.

As there is nothing of particular interest about the lower arch, the treatment will not be considered here.

By looking at the right and left sides of the case shown in Fig. 568, it will be seen that on the right side there is a slight mesial tendency of the lower teeth, but they are not beyond the influence of the cusp, and the case is therefore classed as neutroclusion, or Class I. The left

side shows a normal mesio-distal relation of the molars and the lower arch is short on that side owing to the early loss of the second deciduous molar, which has permitted the space intended for the second premolar to close. Looking at the front view of Fig. 568, and the left side of Fig. 568, it will be seen that the maxillary left incisor is in lingual occlusion to such an extent that it is lingual to the mandibular teeth. In order to get this tooth into its proper position, it is necessary to adjust the expansion arch in the same manner as

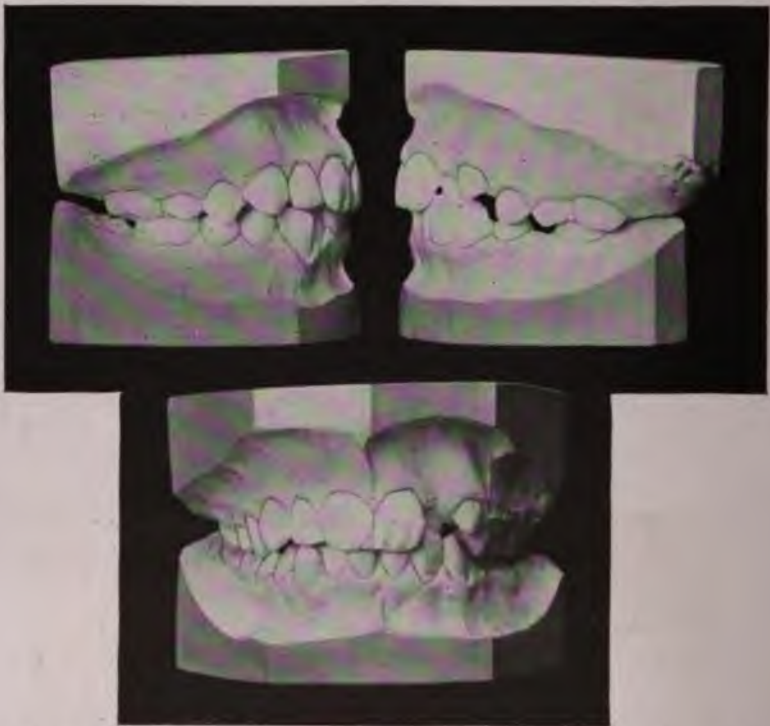


Fig. 568.—Neutroclusion, or Class I, case. Impacted mandibular left second premolar and maxillary left lateral incisor in linguoversion to mandibular.

described in other cases. The arch is adjusted so that it stands away from the teeth slightly, as a general expansion is needed. The premolars are ligated to the arch, as are the incisors. A spur should be soldered to the arch directly in front of the left central incisor so as to prevent the central from drifting to the left as it is carried forward. After the arch is expanded slightly and the anterior teeth carried forward, a ligature is placed on the left lateral and it is carried labially over the mandibular anterior teeth. It has often been

suggested that a gag or some device be put on the teeth to open the bite while the teeth are being carried from lingual to normal occlusion. The author has never found this necessary in his practice. The lower arch will have to be expanded in all regions. In addition

Fig. 569.—Front view, showing upper and lower arches.

Fig. 570.—Spur and long ligature is shown on left side to move canine and premolar forward to make room for impacted second premolar.

to that, it will be necessary to carry the left premolar, canine and incisors forward to make room for the impacted second premolar. The lower expansion arch is adjusted so as to exert force on all of the teeth to carry them buccally and labially. The relation of the expansion arch to the teeth is shown in Fig. 569. The expansion arch must be made wide in the canine region, as it is necessary to expand the dental arch a great deal in order to make room for the incisors. The canines are moved buccally before any attempt is made to bring the lower right lateral forward. The mesial movement of the left mandibular premolar and canine is accomplished by the use of a long wire ligature that engages the premolar and canine, and is twisted in front of a spur that has been soldered to the arch directly mesially to the canine. This spur is attached by soft solder and is

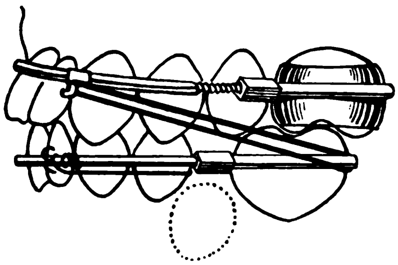


Fig. 571.

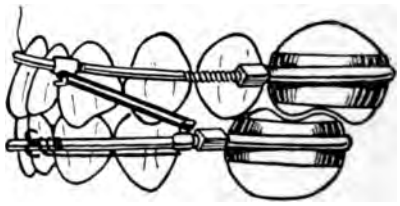


Fig. 572.

Fig. 571.—Intermaxillary rubber placed distal to molar tube to prevent molar from moving distally, as the nut on arch is screwed distally to carry anterior teeth forward to make room for impacted premolar.

Fig. 572.—Intermaxillary rubber placed on intermaxillary hook, which is mesial to nut on lower arch, for the purpose of moving lower teeth forward. No forward force is exerted on lower molar with this plan of attachment.

made by twisting a ligature wire around the arch after the manner described in the making of spurs. Fig. 570 illustrates how this long ligature is placed on the arch. It will also be seen that there is another ligature on the canine, used for expansion. After this long ligature is twisted tight around the premolar and canine, the teeth are carried forward by tightening the nut on the expansion arch. This gives the same movement to the teeth that would occur with a jackscrew. It must be remembered that as much force is being exerted upon the molar as upon the premolar, canine and anterior teeth. Very often the lower molar will be displaced distally, in which case it will be necessary to enlist intermaxillary anchorage in order to hold it in the proper position, or to restore it to its normal position if it has been displaced. In this instance intermaxillary anchorage will be used by placing an intermaxillary-hook on the upper arch in the

region of the upper canine, and adjusting a rubber from it to the distal portion of the tube on the lower molar band. (Fig. 571.) Some have placed an intermaxillary-hook on the lower arch just in front of the nut on the left side and attached the rubber from the hook fastened to the upper arch to the hook on the lower arch. This will prevent any forward pull upon the molar. Where the intermaxillary rubber is used from the upper hook to the distal portion of the lower band, the forward pull of the rubber is counteracted by the backward push of the nut on the expansion arch, and if these forces are kept

Fig. 573.—Front view of completed case shown in Fig. 568.

balanced the molar will not move at all. Should the molar be moved distally before it is discovered that the anterior teeth are causing the molar to be displaced, a rubber is used that is strong enough to pull the molar and lower anterior teeth forward. The different attachments for this use of intermaxillary anchorage are shown in Figs. 571 and 572.

During the treatment of this case, the second left lower premolar came into position. The eruption of this tooth maintains the proper mesio-distal relation of the lower teeth on the left side (Fig. 573). The upper teeth were retained by placing a band on the upper lateral incisor with a spur on the labial side that embraced the central incisor

and canine (Fig. 574). No other retainer was placed on the upper teeth, for with the long cusps it was impossible for the upper arch to narrow unless the lower one did so first. The lower arch was retained by placing bands on the lower canines and by shaping a wire to fit the lingual surfaces of the lower molar. This lingual arch should be made

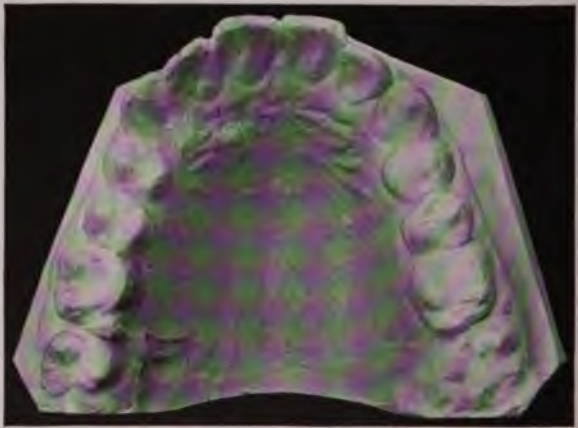


Fig. 574.—Upper impression was made before retaining appliance was placed on lateral.

Fig. 575.—Lower impression was made with retainer on teeth. Lingual bar extended to molars.

of some material that possesses considerable spring. It is soldered to the lingual surface of the canine bands and occupies the position shown in Fig. 575. The narrowing of the mandibular molars is prevented by the spring of the lingual bar, and the pressure can be increased in a buccal direction by grasping the bar distal to the canine band with a pair of pliers and bending it outward.

Fig. 576.

Fig. 577.

Figs. 576 and 577.—Lack of facial development produced by neutroclusion. (Tanzey.)

Fig. 578.—Malocclusion of patient shown in Figs. 576 and 577. (Tanzey.)

Fig. 579.—Occlusion of teeth after treatment of case shown in Fig. 578. (Tanzey.)

Neutroclusion, or Class I, cases present many varieties and produce various effects on the facial outlines, which have been considered in a previous chapter. Neutroclusion cases that have a bunching of the teeth as we have just described produce a lack of development of the dental region of the face, which is shown in Figs. 576 and 577. The position of the teeth is shown in Fig. 578. The proper treatment of the malocclusion resulted in the condition as shown in Fig. 579. The expansion of the arches is shown in Fig. 580. The result of the expansion of the arches and of the placing of the teeth in their proper positions produced the change in the face, which is shown in Figs. 581, 582 and 583.

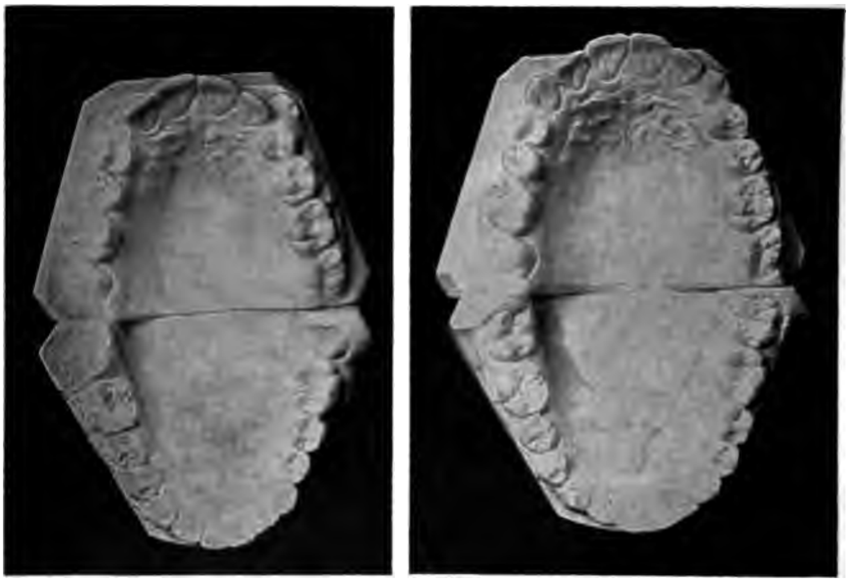


Fig. 580.— Occlusal view before and after treatment. (Tanzey.)

Mutilated Cases of Class I, or neutroclusion, should be treated with a view of restoring normal occlusion as nearly as possible. This means that some artificial substitute should be placed on the teeth that will take the place of the missing teeth or tooth. Considerable has been written on "Compromise Treatment," which means that, in those cases that have been mutilated, some method is followed that will improve the occlusion but will not tend to produce normal occlusion. The compromise method should only be attempted by the experienced orthodontist.

It has long been recognized that one of the most troublesome ques-

Fig. 581.

Fig. 582.

Fig. 583.

Figs. 581, 582 and 583.—Improved facial expression produced by the correction of the malocclusion present in Figs. 576 and 577. (Tanzey.)

tions in the correction of malocclusion of the teeth is found in the treatment of those cases complicated by missing teeth.

If one will go back through the dental literature a number of years he will find that this question has been discussed in several different ways, and at the present time no satisfactory method has been suggested that can be followed in the treatment of all cases. In fact, one of the greatest troubles that seems to arise in considering these cases of malocclusion when complicated by missing teeth, is so many practitioners want to follow a fixed rule in all cases rather than to select a treatment which is best suited to the particular case in hand.

In deciding what plan of treatment is to be followed in reference to missing teeth, we must take into consideration the occlusion and esthetic results, as we find them. We must consider what the result is to be according to what plan of treatment is followed and what benefit it will be to the occlusion and facial outline. We must remember that any plan we choose will not give an ideal result, for the establishment of an ideal occlusion is impossible in cases complicated by missing teeth, whether we replace the missing tooth with an artificial substitute or follow some plan which gives a compromise occlusion, based upon the masticating efficiency of the teeth. After considering the occlusion and esthetic conditions as we find them and carefully considering the changed conditions as the result of the different plans of treatment, we are ready to consider some of the other factors which may be termed difficulties encountered in the treatment of the case. As we have said one of the first things is the age of the patient and the condition of the surrounding tissues. It would be possible to institute extensive orthodontic treatment in a child and move teeth a great distance when the surrounding tissues were healthy, while in an adult where the tissues were not healthy we would not attempt such extensive movement. In a young person where the teeth have not been worn by mastication it might be advisable to change molar and premolar relations, mesiodistally, where the abnormal relation has been produced by missing teeth; while in an older person where use had worn the cusps to occlude in the abnormal position mesio-distally, the best plan would be to leave the molars and premolars where they are.

If it has been decided that the missing tooth should be replaced by an artificial one, the question of prosthetic procedure becomes an important point. In considering this question, we can only do so from the orthodontist's standpoint, and may not agree with prosthetic men. We are aware that the profession is divided upon the question of fixed or removable replacements. In reference to removable replacements, they

must be of such a nature as to retain the normal approximal contact of all the teeth. They must have the proper occlusion and not injure the soft tissue. In reference to fixed replacements of missing teeth, they must be attached at both the mesial and distal sides. It must be an attachment that will mutilate the abutment teeth as little as possible. This means in most cases the use of some form of inlay attachment. The attachment should be made without destroying the pulp of the tooth; it should be made in such a manner as to allow of physiologic tooth movement, under the stress of mastication, when possible. As a result of the difficulties encountered in replacing missing teeth, no one plan exactly fulfills all requirements.

In taking up the question of orthodontic cases complicated by missing teeth, we can also consider the cases according to the tooth that is missing, whether it is an incisor, canine, premolar or molar.

In speaking of missing incisors, the condition of the malocclusion and the age of the patient must be taken into consideration before we decide whether it would be the most advantageous thing to open up the space so that an artificial tooth could be placed. If we have a patient with the incisor missing either congenitally or the result of an accident or disease in which all of the other teeth occupy practically a normal position both approximally and occlusally, as a general rule, the only thing to do would be to use an artificial substitute. After the space has been opened and it has been decided to place an artificial substitute, the question of procedure from that point on becomes one of more or less importance. The first question is, How are you going to place an artificial substitute? To answer this question in a general way we believe that any plan that is followed must be a plan which will support the artificial tooth on both mesial and distal sides. In other words, no artificial tooth which cannot be supported by two teeth should be placed in an orthodontic case. In making this statement we recognize the fact that we are going to be criticized because in doing this it will be necessary to mutilate the two approximating teeth. In mutilating these teeth we are aware of the fact that we will be confronted by the question of whether or not we shall remove the pulp. This particular question will be answered very emphatically, both ways, depending on whether the crown and bridge man is one who believes in "vital" attachments or one who believes in "devitalizing." We recognize the argument on both sides of the question, both from the standpoint of the crown and bridge man and from the standpoint of the orthodontist, as well as the efficiency from the standpoint of the patient; it has seemed to the author that the most important thing to consider in orthodontic cases where missing in-

cisors are being replaced is the question of esthetics and the maintaining of the occlusion of the other teeth. The question of strength and masticating efficiency becomes the third feature of consideration. In other words, orthodontic patients, who have artificial teeth in the anterior part of their mouths should be instructed that those teeth will not stand a large amount of mastication and must be favored. The reason for this advice is that if the case is favored and they are advised that a large amount of mastication cannot be done on those teeth it makes possible an attachment which is better from an esthetic standpoint, although it possesses less strength. Working from the standpoint of esthetics in the maintaining of the occlusion of the remaining teeth, we believe the best plan of attachment is not to "devitalize" the abutment teeth, but to place the missing tooth by means of inlays which can be done without endangering the pulp of the natural teeth.

In attaching artificial incisors by means of inlays, the inlays must be made and placed in such a position as not to endanger the pulp. In a great many cases owing to the close occlusion between the maxillary and mandibular incisors some form of iridio-platinum spur, the ends of which are attached to the inlay, can be used to strengthen the attachment of the artificial tooth. These inlay attachments, being necessarily made small so as to avoid the pulps of the teeth, do not offer as much strength as do the artificial teeth replaced by means of a post. However, the patient must be cautioned that an artificial tooth is inserted primarily for esthetic reasons and will not stand a large amount of mastication. They must also be told that it is more essential that they have a good appearing artificial tooth, without the possibility of causing discoloration in the attached tooth which may occur if the pulp is removed than it is to have one extremely rigid which does not look so well and which may result in discoloration and disease of the attached teeth.

It is better for the patient to have the artificial tooth reattached or recemented several times a year than it is to run the risk which may come from destroying a pulp. The one principal objection in making attachments for artificial teeth by means of inlays in the anterior portion of the mouth, is that owing to the small amount of tooth surface involved it is very difficult to make an attachment which fulfills the physiologic conditions of mastication. It is very difficult to attach the artificial tooth in such a manner that the abutting tooth can respond under the stress of mastication which is one of the physiologic factors. Even though physiologic tooth movement cannot be obtained in the anterior portion of the mouth as satisfactorily as in the case of molars

and premolars, I believe the inlay attachment offers better conditions than any plan which has been followed heretofore.

In cases which involved missing maxillary laterals, I believe a more efficient result from the standpoint of occlusion and mastication and even probably from the standpoint of esthetics can be obtained without opening up the space for the lateral. I refer to those cases which sometimes have been classified according to Angle's plan, as a subdivision

Fig. 584. (Gifford.)

Fig. 585. (Gifford.)

of Class II, which really are not distoclusion cases, but which are cases in which the maxillary molars, premolars, and canine because of loss of approximal contact, have taken a mesial position in regard to the mandibular teeth. In other words, we find the mesio-buccal cusp the maxillary molar occluding between the mandibular first molar and second premolar, with the maxillary first premolar occluding between

the mandibular first premolar and canine and the maxillary canine occluding in the position of the maxillary lateral. In order to open up this space for this missing lateral it would be necessary to move distally all the molars and premolars and canine upon that side. This movement could be accomplished, but it involves a long period of orthodon-

Fig. 586. (Gifford.)

Fig. 587. (Gifford.)

tic procedure which in a patient past the age of twelve would be a very questionable thing to do.

In order to establish anything like an efficient occlusion such as we have in the beginning a bodily movement of all those teeth would be necessary which, while possible, would involve a long period of time and would result in an occlusion which, from a point of masticating effi-

ciency, would be no more satisfactory than the one which we had in the beginning. We believe in a large number of those cases a much more efficient occlusion can be obtained and a dental apparatus produced which will be more serviceable to the patient by leaving the maxillary molars and premolars on the abnormal side in the mesial position and correcting whatever other malocclusions may be present. One of the reasons a better occlusion of the molars and premolars from a masticating standpoint can be obtained by leaving them alone is that the cusps have worn to fit in that position. If the patient had never masticated sufficiently to wear the teeth, this plan would not be so advisable. After the malocclusion is corrected, the maxillary canine which is in the place of the lateral can be ground down and made to resemble a lateral as nearly as possible (Figs. 584, 585, 586 and 587).

I admit that this plan does not give the most ideal esthetic result, but gives a much more efficient occlusion and one which is going to be much more serviceable for the patient than would be obtained by the long orthodontic procedure of moving the molars, premolars, and canine distally and then placing an artificial lateral.

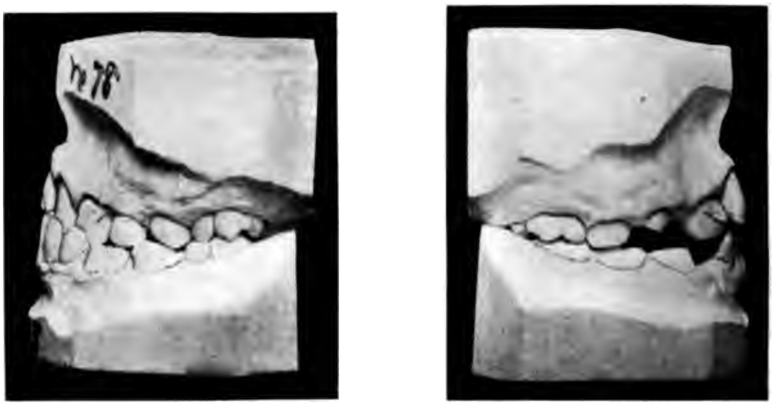
When we consider the question of replacing canines which are seldom missing except as the result of accident or disease, we again must take into consideration the conditions present in that particular case. If we had a case of malocclusion in a comparatively young patient in which all of the remaining teeth occupied a normal mesio-distal relation to the occluding teeth, as a general rule, we would say the maxillary canines should be replaced by an artificial substitute. This artificial substitute should be anchored to both the premolar and lateral, at least the anterior end of the mesial surface of the artificial canine should have some sort of support upon the lateral incisor. This support should be made in such a manner as to maintain normal proximal contact and prevent the lateral incisor from slipping past the artificial canine labially or lingually. We also would suggest that in these cases an inlay be placed in the lateral which would be cemented in place. A cavity or groove should be cut in the inlay for the reception of an abutment or spur from the artificial canine. This would give a support occlusally, buccally, and lingually and still allow for a certain amount of movement between the artificial tooth and the canine under the stress of mastication and thereby more nearly approach physiologic conditions. From our observation, we also believe that in the replacement of a missing canine by an artificial substitute, such attachments should be made as would not destroy the pulp of either the premolar or the lateral.

We find another class of cases in which the canine has been missing

congenitally and the molars and premolars on that side have come forward until the premolar occupies the position intended for the canine with the molars and premolars one cusp mesial to normal. In such conditions as that, we believe it would be much better not to open up the space for the missing canine, but to leave the occlusion as it has been established during the process of development and allow the first premolar to occupy the position of the canine, with all the molars and premolars on that side one cusp mesially. Such conditions as this will give just as good an esthetic result as would be obtained if the canine were in position, for the first premolar has probably erupted in an upright manner and in its forward position the crown and root consequently fills out the corner of the face the same as a normal canine would. The occlusion of the mesial molars and premolars have probably worn in such manner as to make an efficient occlusion which would be just as good from a masticating standpoint as if they occupied their normal positions.

The question of missing premolars, maxillary or mandibular, is very much the same and has to be considered in regard to the age of the patient, the extent of the development of the alveolar process or growth of the jaws, and whether the tooth is congenitally absent or has been lost as a result of accident or disease, and the position of the remaining teeth from an occlusal standpoint. In dealing with premolars that are congenitally absent, I have found in my practice the ones most often missing are the mandibular second premolars. Because of this, I believe it is a good plan in the treatment of every case of malocclusion before the time of the eruption of the premolars to have radiograms made to prove whether the premolar is missing or present. Therefore in treating a case of malocclusion in which we find the mandibular second premolar is absent, I believe a more efficient result from the standpoint of serviceable occlusion can be obtained by instituting a plan of treatment, which will move the mandibular molars forward the width of the premolar, therefore, establishing a mesial occlusion of the mandibular molars with the maxillary molars and closing the space in that manner. Cases treated by this plan prior to the eruption of the second molars have shown that the first molars can be moved forward bodily and the second molars in erupting will take the position approximating the first molar. This plan of treatment produces the normal occlusion of the teeth from the first premolar forward and the mandibular molar one cusp mesial. The masticating efficiency in these cases is far superior to those in which a missing tooth is supplied and one which eliminates the possibility of trouble by making attachments to vital teeth.

The congenital absence of maxillary premolars before the eruption of the second molar should be handled in the same manner, which would consist in the mesial movement of the maxillary molars to close the space of the missing tooth. Fig. 588 is a case described by Gifford in which the second maxillary premolars are missing on both sides. The patient was ten years old. By the use of intermaxillary anchorage the maxil-



A. *B.*

Fig. 588. (Gifford.)

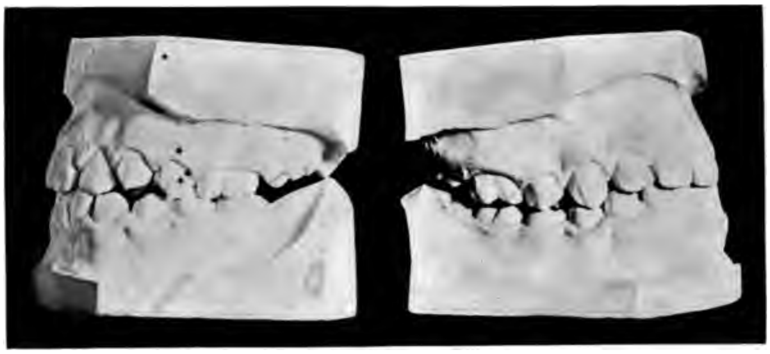


Fig. 589. (Gifford.)

lary teeth were moved forward and the first molar made to occupy a position mesial to the mandibular first molar. Fig. 589 shows the treatment is progressing satisfactorily and the occlusion in the premolar and canine region will become better as those teeth complete their eruption. In cases of advanced age, after the eruption of the second molars, where premolars have been lost as a result of accident or disease, the treatment

in those cases would depend upon the condition of the remaining teeth. If the space for the missing premolar has been closed by a mesial drifting of the teeth distal to the space, in the majority of cases, it is the most advisable plan to straighten up those teeth and restore their use by an artificial substitute. In cases of patients of advanced age, who because of extraction have lost the masticating efficiency, it is not always desirable to attempt a mesial movement of the molars to close up the space made by the premolars. In these cases, which are the result of mutilation, something must be done to improve the masticating apparatus of the patient. We must decide what is going to give the most serviceable results with the least possible sacrifice to the patient and if that plan is followed, which involves the opening up of the spaces, we then have to use artificial substitutes the same as we would in any other class of cases where artificial substitutes are required to improve the function of the teeth. Again, in the replacement of the premolars the same plan must be followed, the replaced tooth must be attached at both ends. Secondly, we believe the best reults can be obtained by means of inlay attachments which may be described as one inlay within another or by some form of removable attachment which allows for individual movement of the teeth during mastication.

When we come to the consideration of missing molars we again must be controlled by the age of the patient and the condition of the malocclusion as we find it. The author believes in young individuals, in children before the eruption of the second molar where the first molar has been hopelessly diseased and has to be sacrificed, the best plan of treatment is to move the second molar forward during the process of its eruption and make it occupy the space formerly occupied by the first molar. Various cases treated by this plan show that by proper orthodontic procedure maxillary and mandibular second molars can be made to assume the position of the first molars, in an upright manner and so produce a very serviceable occlusion. This plan of treatment also avoids the necessity of wearing a mechanical retaining device to keep the space made vacant by the missing first molar. We even find another class of cases, after the eruption of the second molar and before the eruption of the third, in which we believe it is advisable to bring the second molar forward and close the space made vacant by the first molar. We refer to those cases in which the radiogram reveals the first molar to be in such a hopelessly diseased condition that the question of its loss will only be that of a few years. We believe in such cases it is better to extract the first molar in a patient twelve, thirteen, or fourteen years of age and bring the second molar forward bodily to close

up the space made by the loss of the first molar. Upon eruption the third molar will take its position behind the second molar and will generally be a very serviceable tooth. We have observed in these cases where the first molars are lost early, the third molar has always possessed a well developed crown and become a very serviceable tooth which is probably caused by relieving the pressure and bringing the second molar forward and giving the third molar ample room to develop.

Fig. 590 shows a case of neutroclusion complicated by the loss of the permanent molar. It was treated by bringing the first molars forward and closing the space, thereby making a more serviceable occlusion than if the space had been retained for an artificial substitute. Fig. 591 shows the result of the treatment.

Fig. 590. (Gifford.)

Fig. 591. (Gifford.)

Fig. 592 shows a case that is complicated by extraction. The mandibular first and second molars and second premolars below were extracted. The mandibular third molars drifted slightly forward. Owing to the loss of the mandibular molars the mandibular anterior teeth drifted distally until the lower lip was caught under the maxillary anterior teeth and those teeth were forced forward. The general facial appearance of the patient would suggest distoclusion or Class II, but the mesio-distal relation of the arches shows it to be Class I, or neutroclusion. These cases become so extreme that they demand some sort of treatment, and it is to show that something can be done for these unfortunate patients that the author is describing this case. The mandib-

ular anterior teeth occlude against the palatal gums, lingually to the maxillary anterior teeth. This condition was causing a great amount of irritation, which could be corrected only by increasing the length of the molars and the premolars.

In treating this case, it was impossible to attach bands on the lower molars for they were too loose, so it became necessary to use the lower first premolars for anchorage. This position of the mandibular teeth makes it necessary to move all of the lower anterior teeth forward and this was done by the use of intermaxillary anchorage. In order that there will not be much upward pull on the premolars, a bar is soldered to the premolar band, as shown in Fig. 594, which extends

Fig. 592.—A mutilated case of Class I, or neutroclusion.

backward as far as the position occupied by a mandibular first molar. A tube to support the end of the arch was soldered on this bar. The distal end of the band was bent lingually so as to form a "V," which engages the intermaxillary rubber. With this extension bar on the premolar, it is possible to use a regular size arch, which gives a greater range of spring and does not exert much occlusal pull on the premolars.

The upper expansion arch was adjusted so that the anterior portion rested against the maxillary anterior teeth, buccally to the canines and premolars, as shown in Fig. 593. The nuts on the upper arch did not

touch the tube on the upper molar band, for all of the force of the rubber ligature was to be exerted against the incisors. Wire ligatures were placed on the premolars and canines so as to move them buccally.

Fig. 593.—Showing upper appliance in place.

Fig. 594.—Showing lower appliance in place.

The backward pull of the intermaxillary rubbers against the maxillary anterior teeth was also reciprocated against the lower teeth. As the

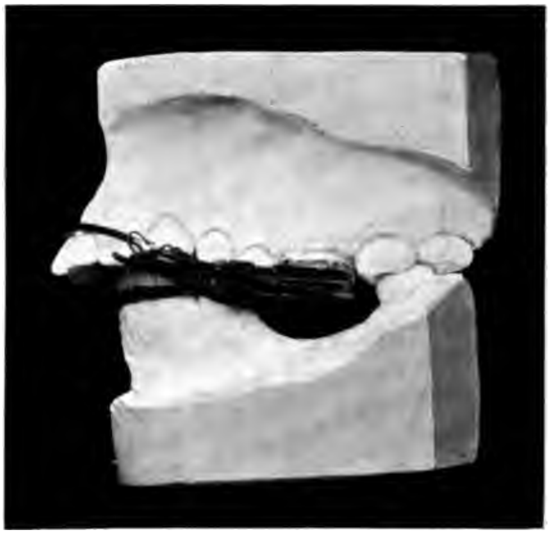


Fig. 595.—Side view, showing intermaxillary rubbers. Compound reciprocal intermaxillary anchorage. Note position of nuts on upper arch.

Fig. 596.—Front view, showing position of upper arch.

maxillary incisors moved distally faster than the lower teeth moved forward, when the maxillary anterior teeth had been moved to their proper position, and the dental arch widened the proper width, the nuts on the upper expansion arch were allowed to rest against the bands on the maxillary molars, so that all of the maxillary teeth were pitted against all of the mandibular teeth (Figs. 595 and 596). The continued use of the intermaxillary rubbers finally moved the mandibular teeth to their proper position. It was then necessary to restore the missing teeth. In this case a gold plate was used. The improvement of the facial outline was very pleasing. The improvement in the occlusion of the teeth is

Fig. 597.—Completed result of case shown in Fig. 592.

shown in Fig. 597. Cases of this type are not attractive to some operators, and many practitioners go so far as to advise against treatment, but these unfortunate people have a right to some relief, and if properly handled, very satisfactory results can be obtained.

The retention of the case consisted in placing an accurately fitting gold plate in the lower, which carried properly occluded artificial teeth with proper mesio-distal contact. This plate retained the lower teeth in their proper position. No retaining appliance was put on the upper teeth, as it was impossible for them to change their position owing to the position of the lower lip and the force of the muscular pressure.

Common forms of neutroclusion, or Class I, cases are those that are mutilated as the result of the extraction of the first molars. These patients often give a history of a normal occlusion prior to the time of the extraction of the first molars. The change is often gradual and

Fig. 598.

Fig. 599.

Figs. 598 and 599.—Front and side view of malocclusion caused by extraction of mandibular first molars.

they are not aware of the trouble that is resulting until it is brought to their attention. In the case shown in Figs. 598 and 599, which was caused by the early loss of the mandibular first molars, the teeth gradually drifted together until the mandibular second molars and the premolars were in contact on both sides. As a result of this drifting, none of the teeth are in normal occlusion. The lower incisors are biting against the upper gums, and to remedy this condition the difficulty presented was to open the space for the missing teeth and to supply an artificial substitute.

Very often, in these cases, it is necessary to open the space only far enough to supply a tooth half the size of the molar, as that is sufficient in some cases to open the bite far enough to prevent the mandibular teeth from striking the upper gums. However, it must be remembered

Fig. 600.—Position of tube on molar band, which must be resoldered so as to assume position shown in Fig. 601.

that it is always necessary to move the lower anterior teeth, or rather the teeth anterior to the missing molars, into their proper position. If the proper space is not restored, it is because the second and third molars are not moved distally to their proper position, for the teeth anterior to them must always occupy the proper mesio-distal relation to the uppers.

In treating these cases, it is necessary to move the molars distally and the teeth anterior to them mesially. Clamp bands are placed on the second molars, and owing to the tipping of these teeth it is always necessary to solder the tube at a different angle from that which it occupies on the band as supplied by the manufacturers. Fig. 600 shows the tipping that usually is encountered in these cases, and plainly illustrates the position that the tube assumes as the band is placed on

the tooth. In Fig. 601 is shown the position to which the tube must be changed. In aligning the tube, the anterior part of the tube should be so placed that the anterior part of the arch rests apically to the gingival part of the teeth, as shown in Fig. 602. This position of the arch is necessary to give a backward and upward tipping of the molar, produced by springing the arch occlusally and wiring the anterior portion of the arch to the anterior teeth. The effect of this action upon the molars is shown in Fig. 603. The side view of the appliance is shown in Fig. 604. Spurs are placed on the lower arch mesially to the canines for the purpose of using the long ligatures to bring the premolars and canines forward. The ligatures on the anterior teeth carry them forward as the nuts on the arch are tightened. The tightening of the nut exerts a backward force on the molars and a forward force on the anterior teeth.

Fig. 601.—Position of arch, which is sprung up to tip molar backward.

Under ordinary conditions the anterior teeth would move more rapidly than the molars, but it must be remembered that the molars have a tipping force exerted on them by the spring of the arch. If the molars do not move distally as fast as they should, and there is danger of moving the anterior teeth too far, intermaxillary anchorage can be used, with the rubber running from the tube on the maxillary molar band to an intermaxillary hook on the lower expansion arch opposite the canine. It would be necessary to adjust an alignment wire on the upper teeth, which was not used in this case, if intermaxillary anchorage was employed. The upper arch required expansion only in the canine and premolar region, and this was accomplished by placing plain bands on the canines to which was soldered a lingual spur that rested against the maxillary first premolar. On the labial surface of the canine band was soldered a horizontal tube that received the 18-gauge wire that

supplied the expansive force. The appliance is shown in Figs. 604, 605, 606, and 607.

After the space has been provided, the retention will consist in restoring the missing tooth by some means as indicated in crown and bridge work. The position of the anterior teeth can be retained by any of the retaining devices mentioned heretofore that meet the requirements of the case.

In the treatment of mutilated cases, or other cases where there are missing teeth, one of the unsatisfactory problems is the replacing of the missing tooth with an artificial substitute. The replacement of the missing tooth with the artificial tooth presents more problems than was at first imagined. In order for the replaced tooth to be of the greatest use, it must be so made as to present the proper masticating

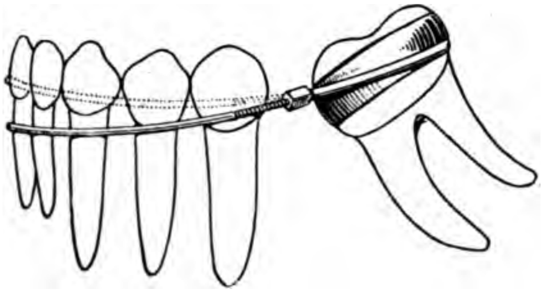


Fig. 602.

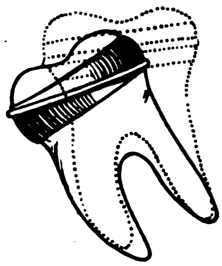


Fig. 603.

Fig. 602.—Showing gingival position of arch, which must be sprung occlusally, as shown by dotted line, and wired to anterior teeth to tip molar distally.

Fig. 603.—Dotted tooth form illustrates result of action as outlined in occlusion.

surface and also to have the proper mesio-distal diameter. The fact that a great many methods make necessary the mutilation of the teeth to which the artificial tooth is attached, has caused many to try to avoid the use of artificial substitutes more than they have in times past. In those cases in which the first molars are lost early, it is possible to move the second molars forward in an upright position and to close the space and make the second molar take the place of the first. It is true that the second and first molars are not of the same shape, but by closing the space after the manner suggested, we avoid the necessity of mutilating the teeth for the attachment of artificial teeth and do not compel a young patient to go through life with some form of artificial tooth in his mouth. However, in the cases in which the remaining teeth are moved to close the vacant spaces, there must

Fig. 604. Appliance as first placed on molars. Side view.

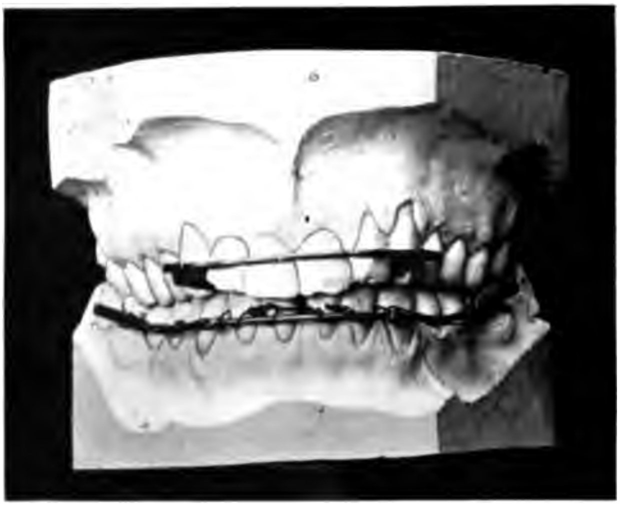


Fig. 605. Shows model with lower appliance in place. Small arch was placed on canines to expand upper arch in canine region.

be a careful diagnosis, and the case must be selected that is suitable for such treatment. The case shown in Fig. 604 could be benefited only by opening the space, as the teeth posterior and anterior to the

Fig. 606.—Occlusal view of upper appliance to expand canines and premolars.

Fig. 607.—Model of mandibular teeth with appliance adjusted, showing how space has been made for extracted tooth.

missing tooth had tipped to such an extent that the mandibular teeth were impinging against the upper gum. In young patients it is possible to bring the second molars forward and produce more satisfactory

results where the first molars are missing than to attempt to maintain the space and insert an artificial substitute.

In a great many cases of neutroclusion, it is possible to use the lingual wire, which makes an appliance that is less bulky and conspicuous than the labial wire.

Fig. 609 shows the front view of the model of a patient six years of age, with an underdeveloped upper and lower arch. Fig. 610 shows the occlusal view of the upper arch with a bunching of the deciduous incisors; a lack of development between the maxillary canines. There is also a crowding of the mandibular permanent incisors, which can be seen in Fig. 609. This crowding is the result of the lack of development

Fig. 608.—Made during treatment. Compare with Fig. 598.

of the lower arch, which in turn is also retarded by the lack of development of the upper arch. The lingual alignment wire was placed on the maxillary teeth, as shown in Fig. 611, with bands upon the deciduous molars. By pinching the lingual alignment wire in the incisal portion, the angles that rest against the deciduous canines are carried away from each other, resulting in expansion in the canine region, which will also cause some expansion of the molars. As the upper dental arch is widened, thereby giving more room for the lower arch, the lower arch developed and the teeth were forced buccally by the action of the tongue assisted by the force of the inclined plane of the mandib-

ular teeth with the maxillary permanent and deciduous molars. In taking cases at this age it is not always necessary to place an appliance on both arches as the lingual arch is used only on the maxillary teeth. By pinching the lingual wire the development of the upper dental arch occurred, as is shown in Figs. 611 and 612, and the appliance is much less conspicuous than many other appliances would be and causes little

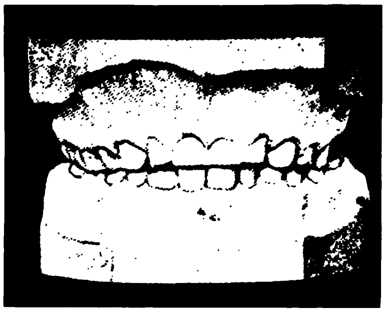


Fig. 609.—Front view of case showing lack of development. (Lourie.)

Fig. 610.—Occlusal view showing lack of development of upper arch. (Lourie.)

Fig. 611.—Upper arch with lingual wire in place. Compare with Fig. 610 for amount of development obtained. (Lourie.)

annoyance to the patient. The use of the lingual alignment wire in neutroclusion cases offers many possibilities.

The lingual wire soldered to the molar bands can also be used successfully in cases of neutroclusion with the canines in infra-labioversion. Fig. 613 shows the front view of such a case. Bands were made for the first molar and a 19-gauge lingual wire was fitted to rest against the premolars and lateral incisors. In the beginning of the treatment the lingual wire did not touch the central incisors; as it would be brought into contact with them when the arch was expanded and the laterals

moved forward. By pinching the lingual wire with the wire-stretching pliers in the region between the canines, the premolars and molar region would be expanded. By pinching in the premolar region the lingual wire would be lengthened and the incisors carried forward. Fig. 614 shows the occlusal view of the case and the position of the lingual wire. It will be seen that there are finger springs soldered to

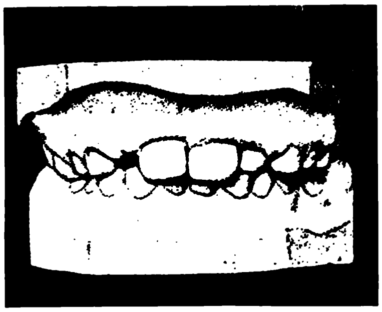


Fig. 612.—Front view showing development as result of use of lingual arch. Compare with Fig. 614. (Lourie.)

Fig. 613.

Fig. 614.

the lingual wire extending labially between the premolar and canine, and they are bent gingivally to engage the labio-gingival portion of the canine. These finger springs are made from 22-gauge spring gold. Fig. 615 shows the front view of the appliance and the appearance of the finger springs over the canines. These canine finger springs can be adjusted so as to exert a linguo-occlusal pressure on the canines and cause them to assume the position shown in Fig. 616. The same appli-

ance was used on the lower without the canine finger springs. This gives a very compact and inconspicuous appliance and if one has mastered the technique of using the wire-stretching pliers and bending finger springs, it is second to none.

A complication often found in neutroclusion cases is that of impacted

Fig. 615.

Fig. 616.

teeth. Any tooth may be impacted in either set and the treatment will depend upon other conditions present. In some instances the impaction of the permanent tooth is caused by an encysted supernumerary tooth and in others the bone overlying the erupting tooth does not absorb and seems to be dense. We often find deciduous molars become impacted during the eruption of the permanent molars to such an ex-

tent that they become imbedded in the gum and require some treatment to stimulate the proper development of the arch in that region. Fig. 617 shows such a case. The appliance consisted of a band to fit the impacted deciduous molar which was made from a measurement obtained from the deciduous molar on the opposite side. In order to afford a stronger attachment for the cement a cusp was wedged for the band which made a crown to fit over the occlusal surface of the impacted tooth. The first deciduous molar, canine and incisors were utilized as anchor teeth, by casting a silver crib to fit over them as shown in Fig. 618. Half round tubes were soldered on the buccal and lingual surface of the crown that was made for the impacted deciduous molar for the purpose of receiving the ends of the spring wires that were soldered to

Fig. 617. (Richardson.)

Fig. 618. (Richardson.)

the crib that fits the anterior teeth. When the two parts of the appliance are cemented in place the free ends of spring wires are sprung beneath the half round tubes on the deciduous molar crown and exert an occlusal force on the deciduous molar which produces a development of the structures in that region.

Impactions of any of the permanent teeth anterior to the molars can best be handled by the use of finger springs soldered to the lingual wire. Fig. 619 shows a lingual appliance that was used in the treatment of two impacted canines. The tissues were removed from over the canines and holes were drilled into the tooth to receive a spur that was attached into the canine. In fastening a spur with an eyelet into the canine it has been suggested that the hole in the canine be threaded and the spur also threaded. The eyelet is then screwed into the threaded hole in the canine and the cement only acts as a medium of protection. The end of the finger spring on the lingual appliance is made into an eyelet for the purpose of receiving a ligature which is tied into the eyelet attached

to the canine. The finger springs should be made out of 24- or 22-gauge spring gold. The appliance shown in Fig. 619 was used to treat the impaction of the canines until the teeth were nearly in proper position in the dental arch. To complete the movement into the dental arch and correct the torsiversion of the canines, finger springs were soldered to the buccal surface of the molar bands, and the lingual wire was left to reinforce the molar anchorage. The appliance is shown in Fig. 620. In some cases the permanent molars become impacted. The first molar may become impacted on the distal surface of the second deciduous molar or the second or third molar may become caught on the tooth mesial. An excellent appliance for use in such impaction is the ligature jack as used by Lourie and described in Figs. 221, 222, and 223.

Fig. 619.

Fig. 620.

Bilateral Distoclusion with Labioversion, or Class II, Division 1

Bilateral distoclusion with labioversion, or Class II, Division 1, cases are those that are characterized by the distal relation of the lower arch, the width of one premolar. It is very seldom that we find the mandibular teeth distal to a greater extent (Fig. 621). The upper arch is narrow, maxillary anterior teeth protruding, underdeveloped chin, underdeveloped mandible, short upper lip, thickened lower lip (Figs. 622 and 623), abnormal muscular pressure, further complicated by abnormal breathing. In fact, long-continued mouth-breathing may be said to be responsible for all of the conditions found in Class II, Division 1. Mouth-breathing is usually caused by adenoids, for a full description of which see Chapter IV.

The first requirement in the treatment of these cases is to make certain that all nasal obstructions have been removed. It should be

recalled that the nasal cavity in these patients is always undersized, which has been caused by the lack of proper development, as a result of mouth-breathing, and lack of atmospheric pressure brought about by disuse. The lack of development of the nasal cavity can be remedied only by widening the dental arch, which produces a transformation in the bones forming the nasal cavity. It is often found that the nasal septum is deflected in a large percentage of these cases, which is due in part to the improper development of the bones that make up the nasal cavity. While it is a fact that these patients gen-

Fig. [illegible]1. Extreme distal (posterior) relation of lower arch.

erally seek relief for the malocclusion, still they will always be greatly benefited by the change that will occur in the nasal cavity as a result of the proper treatment of the malocclusion.

Owing to the extreme facial deformity present in distoclusion with protruding superior anterior teeth, or Class II, Division 1 cases, the literature on orthodontia is full of these cases and of the different plans of treatment. In fact, the advancement of orthodontia may be traced through the advancement of the technique in the treatment of distoclusion cases, or Class II, Division 1, cases. Therefore, it will be appropriate to state briefly the different plans of treatment as practiced in the past and at the present time.

One of the first plans that we have any record of is one in which the case was treated by the extraction of some teeth. An upper pre-

molar on each side was extracted; first, to establish harmony in the size of the arches, and second, to reduce the protrusion of the upper

Fig. 622.

Fig. 623.

Figs. 622 and 623.—Class II, Division 1 case, caused by mouth-breathing.

Fig. 624.—Typical case of Class II, Division 1.

anterior teeth. This plan of treatment made the upper arch conform to the underdeveloped lower arch, improved the occlusion slightly and

changed the facial profile. Normal occlusion and normal facial outlines were not recognized by this plan.

Owing to the unsatisfactory facial results and the lack of normal occlusion, the next method of treatment to attract attention was the one introduced by Kingsley and known as "Jumping the bite." This plan has for its object: First, the establishment of the normal relation of the arches by reducing the protrusion of the superior anterior teeth; second, the forward movement of the mandible, which improves the facial outlines; and third, the establishing of normal occlusion of the teeth.

It will be seen that the results that were hoped for in this plan of treatment were much more attractive than those that were obtained by the other method of procedure. The treatment, in brief, was to expand both the upper and the lower arches and reduce the protrusion of the mandibular anterior teeth until both arches were of the same size and shape. Then the mandible was moved forward by muscular action until the teeth were in their proper mesio-distal relation. The forward movement of the mandible remedied the deformity that resulted from the underdeveloped chin. The facial outlines and the occlusion of the teeth were much improved immediately following the completion of the treatment. However, the trouble was that great difficulty was encountered in getting the mandible to stay forward after it had been moved by muscular action. Various forms of retaining appliances were devised and the hope for permanent results was based on the belief that the temporo-mandibular articulation would change, so as to keep the mandible in its new position and also that the body of the mandible would change. Owing to the great tendency of the ligaments to pull the mandible back to its former position, the author has grave doubts as to the number of cases treated by this plan that could be said to be entirely successful. The two plans above mentioned were not wholly satisfactory and therefore orthodontists were constantly seeking something that would promise better results.

With the use of intermaxillary anchorage, as described by Baker and used on a distoclusion, or Class II, Division 1 case, a new plan of treatment was given to orthodontia. With the use of intermaxillary anchorage, it became possible to move the maxillary teeth backward and the mandibular teeth forward. The forward movement of the lower teeth was the great feature of intermaxillary anchorage. Up to that time there was no means of bringing about this condition, for the plan known as "Jumping the bite" moved the teeth only as the mandible

was moved by muscular action. After Baker described the treatment of his case, Angle began the use of intermaxillary anchorage in distoclusion and mesioclusion cases. The following was accomplished:

1. Establishment of the normal mesio-distal relation of the inclined planes of the teeth.

2. Widening of the upper arch and reducing the protrusion of the maxillary anterior teeth.

3. Movement of the maxillary teeth backward and the mandibular teeth forward, bringing about the normal relation as described in paragraph one.

4. Improvement of the facial outlines of the individual by so doing.

5. Production of normal muscular action by making it possible for the individual to close the lips over the teeth.

6. Making normal breathing possible because the patient could close the lips.

More satisfactory results could be obtained with this plan of treatment than from any of the others mentioned. The great improvement was the result of having moved the lower teeth forward. However, normal occlusion was not always established by obtaining the proper relation of the inclined planes; for in moving the maxillary teeth backward and the mandibular teeth forward, a tipping of the teeth was produced, which was not desired. After the treatment of these cases it often occurred that the chin and mandible would be undersized. For this reason it was believed that better results would be obtained if the plan of treatment was changed slightly, which resulted in the following plan, the object of which was to establish normal occlusion of the teeth: First, by widening the upper arch and retracting the protruding upper anterior teeth; second, by moving the lower teeth forward the entire distance (do not move the upper molars backward); third, by making such anchorage and attachments as would prevent the lower teeth from tipping, which would bring them forward in an upright position. As a result of this plan, the best facial outlines were obtained, the mandible was developed to its normal size, the muscular action became normal and the chin was developed.

It has been shown in the majority of these Class II, Division 1 cases that the maxillary molars are not too far forward. Such being the case, a plan that would approach the ideal result must be one that *will not move* these teeth backward. Therefore, our efforts should be directed toward moving the lower teeth forward and developing the mandible.

By examining a large number of these cases, by studying the facial outlines and the anatomy of the temporo-mandibular articulation, the

author is convinced that the great deformity that we encounter in these cases in the mandibular region is the result of the underdevelopment of the mandible and is not the result of the distal location of the condyle. These cases are micromandibular development and not postversion of the mandible. Therefore our treatment should be of such a nature as will produce a development of the mandible that can be brought about by the last-named plan.

Distoclusion with protruding upper anterior teeth, or Class II, Division 1 cases are found at all ages—even in children who possess only deciduous teeth. It is the opinion of some that the condition may be congenital; but in most instances it is the result of some acquired pathologic condition, usually mouth-breathing, the mouth-breathing generally being the result of adenoids. Treatment is indicated as soon as the malocclusion is discovered, for only complications can come by waiting.

Fig. 625.—Distoclusion with labioversion of anterior maxillary teeth. Class II, Division 1 case. Patient five years of age.

Fig. 625 shows a case of distoclusion, or Class II, Division 1, at five years of age. This case gave a clear history of adenoids, the patient having been operated on one year previously. Plain bands were placed on the second deciduous molars, after wire had been placed between them and the first deciduous molars to produce separation. An eighteen-gauge arch was used, as very little force was required to move the teeth. The upper arch was so adjusted that it rested against the superior anterior teeth and assumed a position away from the canines. The sheath-hooks were placed on the upper arch opposite the canines; the lugs on the upper arch were not allowed to rest against the tubes on the molar bands at the beginning of the treat-

ment; wire ligatures were placed on the superior canines so as to produce widening in the canine region. The position of the arch, ligatures and lugs is shown in Figs. 626, 627, and 628.

Fig. 626.

Fig. 627.

Figs. 626 and 627.—Front and side view of appliance used on Fig. 625.

ed on the mandibular teeth with the anterior
vith the anterior teeth, with a slight space
the arch, as there is a demand for a slight
egion; the lugs on the lower arch are against
nds, for it is the intention to bring all of the

Fig. 628.

Fig. 629.

al view of appliance used on case shown in Fig. 625.

Owing to the ease with which the mandibu-
of the intermaxillary ligature, which will de-
teeth, will also start the mandibular teeth to
canines of the upper teeth are expanded, the

pull of the intermaxillary rubbers will depress the anterior teeth without destroying the approximal contact of the teeth. After the maxillary anterior teeth have been moved distally to their proper position, which is determined by the shape of the dental arch, the lugs on the expansion arch are allowed to rest against the molars and the expansion arch so changed in shape that it rests passive in contact with all of the teeth. All of the teeth are then ligated to the expansion arch so as to obtain as much resistance as possible, which is used as anchorage in moving the mandibular teeth forward. The continued use of the rubber ligatures will move the mandibular teeth forward until they

Fig. 630.—Finished result of Fig. 625.

occupy the position shown in Fig. 630. The teeth were retained by the use of passive intermaxillary retention, consisting of a band placed on the maxillary second deciduous molar with an inclined plane on the distal side of it, which engaged the distal portion of the mandibular second deciduous molar. (Fig. 631.) This device was worn until the first molars began to erupt, and was then taken off. Bands were placed on the mandibular canines with a bar soldered to the lingual side to maintain the expansion in that region, but nothing was placed on the maxillary anterior teeth; for if the mandibular teeth are held and lip pressure is normal, the maxillary teeth will remain normal. If the lip pressure is subnormal, retaining appliances will hold the teeth mechanically only, and when removed the teeth will return to their former position

ppliance was worn. Therefore, greater at-
natural forces of retention than has for-

ase of distoclusion with protruding upper
Division I, at the age of seventeen years.
ent is shown in Figs. 634 and 635. The

hold mandibular molar forward.

and underdeveloped mandible are char-
order to improve the facial outline of the
to move the mandibular teeth forward,
the protrusion of the maxillary ante-

be advanced by moving the lower teeth
development of the mandible.
contact points of the first
After the wire has remained
bands are placed on the
screws lie close to the lin-

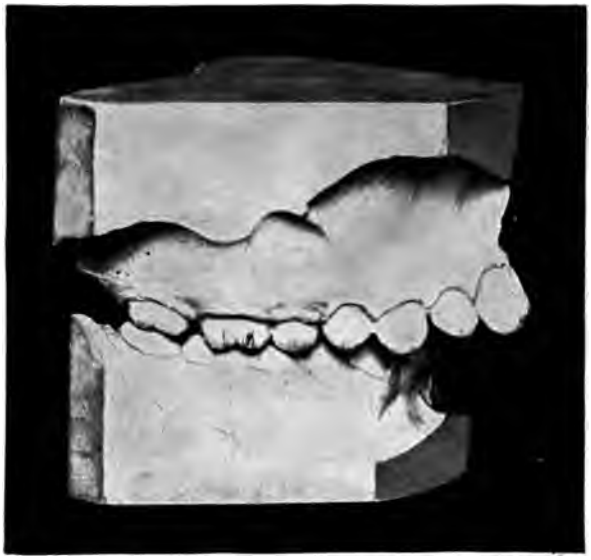


Fig. 633.—Distoclusion with labioversion of anterior maxillary teeth. Class II, Division 1. Patient seventeen years of age.

Fig. 634. Fig. 635.

Figs. 634 and 635.—Effect of mouth-breathing and distal relation of lower arch. Short upper lip, underdeveloped mandible.

gual surfaces of the premolars. If the tubes on the bands do not occupy the proper position, they are removed and soldered so that the arch will occupy the proper relation to the teeth. The position of the

Fig. 636.—Side view, showing intermaxillary anchorage.

Fig. 637.—Front view, showing intermaxillary anchorage.

upper expansion arch is shown in Fig. 636. It will be seen that the anterior part of the arch rests against the maxillary anterior teeth; that the arch stands away from the canines, for they must be expanded; and that the nuts are screwed forward in order not to touch the tubes on the molar bands. These details must be observed carefully in or-

Fig. 638.

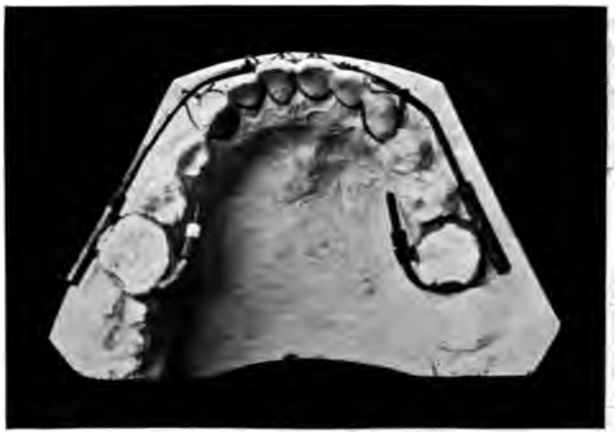


Fig. 639.

Figs. 638 and 639.—Occlusal view of appliances. Upper arch rests against anterior teeth, nuts away from tubes. Mandibular anterior teeth ligated to arch and nuts against tubes.

der to secure the greatest benefit from the regulating appliance. At the beginning of the case, wire ligatures are placed on the maxillary canines and first premolars (Fig. 638), which makes reciprocal anchorage between the two sides. Intermaxillary anchorage is used on this case, the lower arch having been adjusted as follows: The lower

Fig. 640.—Condition of teeth at the time active intermaxillary anchorage was employed.

Fig. 641. Fig. 642.

Figs. 641 and 642.—Changed facial results.

expansion arch is placed on the lower teeth so that it will occupy the position shown in Fig. 637. Slight expansion is indicated in the canine region, but the anterior part of the arch should rest against the lower anterior teeth, for they are to be carried forward only as the molars and premolars are carried foward by intermaxillary anchorage (Fig. 639). The lower incisors may be prevented from tipping by soldering spurs on the arch, as shown in Fig. 551 and then ligating the teeth to the arch. The spur causes the tooth to maintain a perpendicular position. Should it be necessary to move the apex of the tooth faster than the crown, this can be accomplished by placing a rubber between the tip of the spur and the tooth.

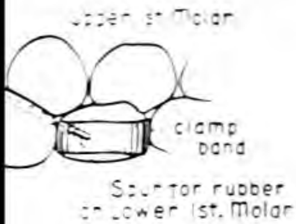
Fig. 643.—Retention of case shown in Fig. 633.

After the upper teeth have been expanded and the anterior teeth brought to the proper position with each other, the nuts on the upper arch are allowed to touch the tubes on the upper molar bands so that the resistance of all of the upper teeth will be pitted against all of the lower teeth.

It is an anatomic fact that more force is necessary to move the upper teeth backward than is required to move the lower teeth forward, and this knowledge aids us materially in the treatment of this class of cases. The continued use of intermaxillary anchorage will bring the lower teeth forward to their proper position, but they must not be moved rapidly.

In the majority of distoclusion, or Class II, Division 1 cases, a con-

... of the lower molars. ... after an examina- ... convinced that the diffi- ... best results will be ob- ... an elongation of the ... with the mandibular an- ... The position of the man-



... Fig. 33.

... Fig. ...

... pull of the rubbers tends ... being brought forward. If attempts ... be too much elongation of ... important that we watch ... employed evenly balanced. ... had been moved to their ... can be seen by compar-

ing Figs. 634 and 635 with Figs. 641 and 642, the latter having been made after treatment. The movement of the lower teeth forward has caused a lengthening of the mandible.

The retention of the case consisted in placing bands on the upper canine and soldering a wire on the labial surface of the bands so as to rest against the labial portion of the teeth (Fig. 643). The wire is placed on the labial side in order to secure greater efficiency. A small

Fig. 646.

Fig. 647.

Figs. 646 and 647.—Occlusion plan of retainer used on case shown in Fig. 633.

spur is soldered on the disto-labial portion of the canine band (Figs. 644 and 645) to engage the intermaxillary rubber that will be used in retention. In order that this retaining appliance may be of any value, the wire extending from one canine to the other must be made of some material rigid enough to hold the canines labially, for if they "collapse" all of the upper teeth will move to positions of malocclusion. The retainer is shown in Fig. 646.

Fig. 648.—Model showing triangular spur and tube used with lingual wire. (Fernald.)

Fig. 649.—Square labial wire used to hold anterior teeth and prevent rotation of canines. (Fernald.)

The lower teeth are retained by making plain bands for the first molars and canines. A wire is shaped to fit the lingual side of the teeth and is soldered to the lingual side of the bands that retain the teeth, as shown in Fig. 647.

A spur is soldered on the mesio-occlusal angle of the molar bands to engage the intermaxillary ligature that is used for retention (Fig.

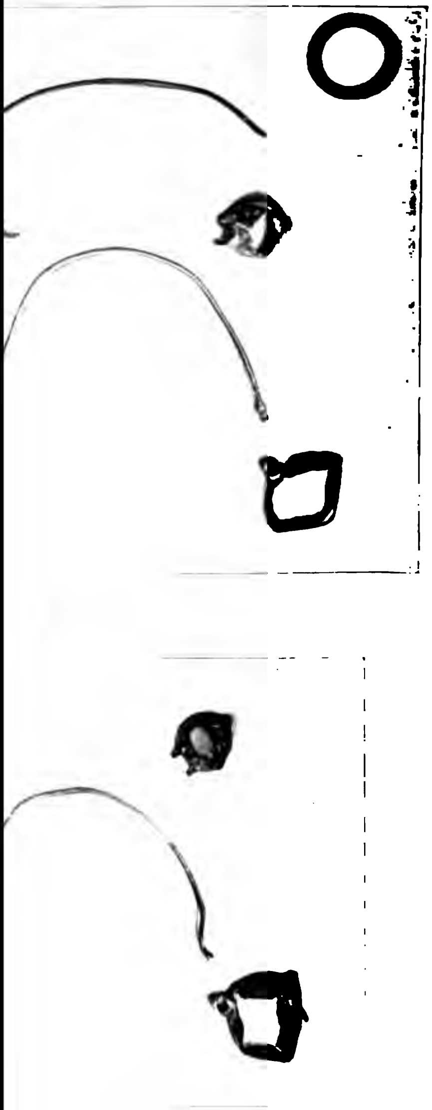
645). The mesio-distal relation of the teeth is retained by wearing the intermaxillary rubbers. These rubbers must be strong enough to resist the backward tendency of the teeth. This form is called active intermaxillary retention. It holds the lower teeth forward, and the constant pull of the rubber ligatures holds the lower molars in their proper position and relation, as they have been moved from infraocclusion.

One of the difficulties with the form of retaining appliances, as shown in Figs. 646 and 647, is that the appliance is too rigid and fixed and does not permit the removal of the parts for the brushing of the teeth. To obviate this difficulty, Fernald has designed a lock for use with the lingual retaining wire, which makes it possible to remove the

Fig. 650.—Position of lingual wire locked in molar tubes. (Fernald.)

lingual wire. The lock consists of a triangular tube and a triangular spur that fits into the triangular tube. The tube is soldered to the band and the spur is soldered to the lingual wire. An enlarged model of the device is shown in Fig. 648. Plain bands are made for the molars to which the triangular split tube is soldered. Plain bands are made for the canines, which have a notch made on the lingual side into which the lingual arch rests. On the labial side of the canine bands is soldered a square tube perpendicular with the long axis of the tooth that is to receive the end of a square wire, as is shown in Fig. 649. This square wire resting in the square tube prevents the canines from rotating as a result of the pull of the intermaxillary

[redacted] nd by changing the relation of the end of [redacted] be, a variety of movements of the canines

[redacted] 

[redacted] separate. (Beaser.)

[redacted] it be desired. A spur is soldered on [redacted] band for the attachment of the in-

termaxillary rubber. Fig. 650 shows the position of the lingual wire with the locks on the lingual sides of the molar bands and the lingual wire resting in the seat on the canine band. A removable retaining appliance for use in distoclusion cases has been designed by Beaser. The various parts of the appliance are shown in Figs. 651 and 652.

Fig. 653.

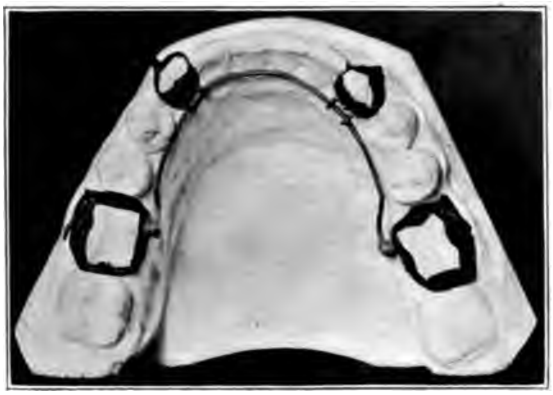


Fig. 654.

Figs. 653 and 654.—Removable retaining wire in position on models. (Beaser.)

The appliance may be made from any kind of material and consists of plain bands for the molars and canines. A 16-gauge vertical tube is soldered on the lingual surface of the molar bands and a slot cut into the tube from the occlusal end, large enough to permit a 20-gauge wire to slip into it easily. The lingual wire is fitted to the

lingual surface of the teeth on the model, and the end of the wire is cut off flush with the inner surface of the vertical tube. To the end of the lingual wire is soldered a piece of 16-gauge wire, which is cut

Fig. 655.

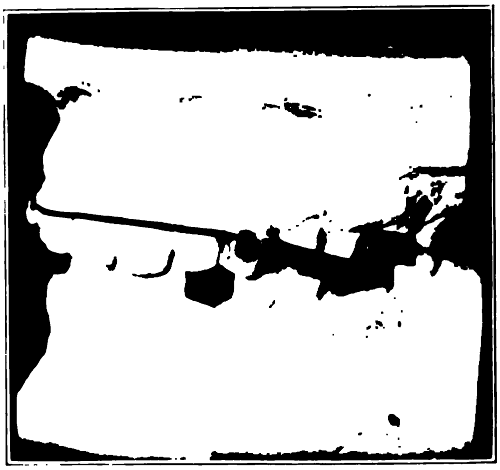


Fig. 656.

Figs. 655 and 656. Intermaxillary rubbers used with removable retaining appliance. (Beaser.)

off the same length as the vertical tube, and makes a "T" on the end of the lingual wire. This piece of 16-gauge wire fits in the vertical tube with the 20-gauge lingual wire lying in the slot and prevents

the molars from rotating. Small hooks are soldered to the linguocervical border of the canine bands to engage the lingual wire and to hold it in place (Figs. 653 and 654). To prevent the outward tendency of the anterior teeth, a piece of 18-gauge tubing is soldered on the labial surface of the canine bands and a slot is cut into the tube mesially and distally from the cervical end about two-thirds of its length, large enough to permit the passage of a 20-gauge wire. This

Fig. 657.

Fig. 658.

Figs. 657 and 658.—Side and front views of distoclusion case. (Lourie.)

can best be accomplished by cutting the tube about half through for the desired length and then soldering to the band. A piece of 20-gauge wire is then cut the desired length, which is long enough to make a hook on each end after it is adjusted to the incisors and slipped in place in the notch in the tube on the canine band. To prevent rotation of the canine, an 18-gauge spur is soldered on the 20-gauge

labial wire to pass into the 18-gauge tube on the canine band. Intermaxillary rubbers are adjusted from hooks that have been soldered on the lower molar bands to the bent end of the 20-gauge wire in the incisors (Figs. 655 and 656).

Distoclusion, or Class II, Division 1 cases can also be successfully treated by means of the lingual arch used in combination with the labial

Fig. 659.—Occlusal view of case shown in Figs. 657 and 658. (Lourie.)

Fig. 660.—Occlusal view of Fig. 659 with lingual arch in place. (Lourie.)

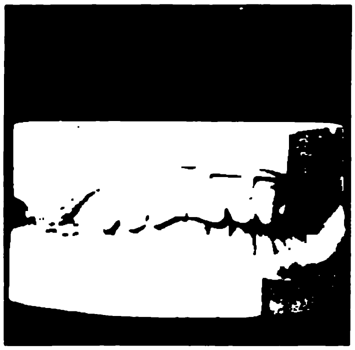


Fig. 661.—Labial wire with spur extensions which make an inconspicuous appliance. (Lourie.)

Fig. 662.—Study model of case shown in Fig. 657 made during treatment. (Lourie.)

arch and spur extensions, thereby making an appliance that is not so conspicuous as when the regular labial arch is used. Figs. 657 and 658 show a case of distoclusion with protruding upper anterior teeth. Fig. 659 shows the occlusal view of the upper model, which shows the expansion necessary in the canine and premolar region. Plain bands were adjusted to the upper molars, which carry buccal tubes as shown in Fig. 660. Fig. 660 is a study model that was made during treatment

and shows the application of the lingual arch. The lingual arch was soldered to the lingual side of the molar bands, and by pinching the lingual wire with the wire-stretchers the dental arch was widened. The lin-

Fig. 663.—Photograph of patient wearing labial arch with spur extensions. (Lourie.)

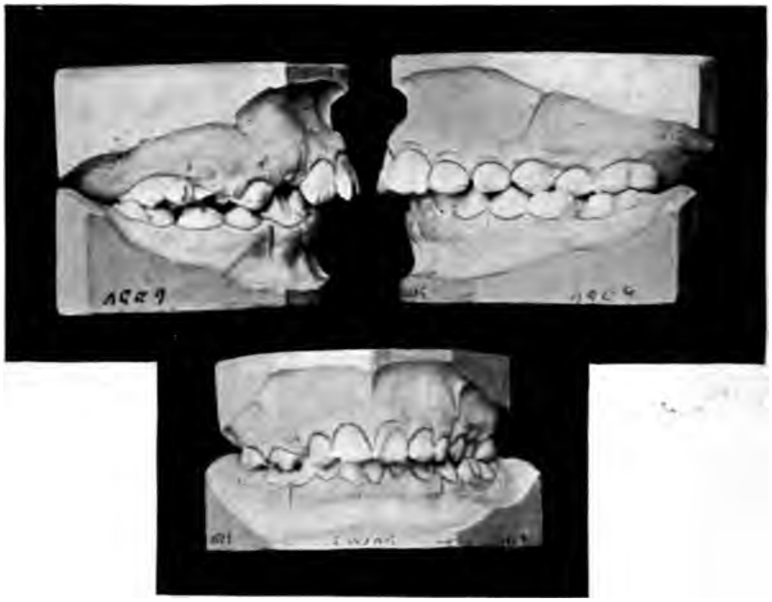


Fig. 664.—Class II, Division 1, Subdivision case unilateral distoclusion with protruding maxillary anterior teeth.

gual arch was made of 19-gauge iridio-platinum and rested against the premolars and canines but did not touch the incisors, as they were moved

Fig. 665.

Fig. 666.

Figs. 665 and 666.—Facial outlines of Class II, Division 1, Subdivision.

Fig. 667.

Fig. 668.

Figs. 667 and 668.—Showing facial outlines after development of mandible.

with the spurs on the labial arch. Fig. 661 shows the labial arch with the spur extension, which rests against the incisors and carries them distally as the lingual arch widens the canine and premolar region. This appliance does not require any ligatures on the maxillary teeth and the only part that is visible is the small extension spurs on the labial arch. Intermaxillary anchorage is used in the usual manner to shift the mesio-distal relation of the arches. Fig. 662 is a study model made to show the mesio-distal relation of the arches, and shows clearly the progress of treatment. Fig. 663 shows the small amount of the appliance that is visible in the patient's mouth.

Unilateral Distoclusion with Protruding Anterior Teeth, or Class II, Division 1, Subdivision

Unilateral Distoclusion, or Division 1, Subdivision, includes such cases as are distal on one side and normal mesio-distally on the other (Fig. 664). They present the same other symptoms as are found in the division. Unilateral cases are treated in very much the same manner as the bilateral. It is necessary to widen the upper dental arch and to reduce the protrusion of the upper anterior teeth. This is done by adjusting the upper expansion arch in the same manner as is done in the division just described. The lower expansion arch is also adjusted as was done in the division. Intermaxillary rubbers are placed on the appliance to reduce the protrusion of the maxillary teeth and the maxillary canines are widened as they were in the case above mentioned. After the maxillary anterior teeth have been moved backward to the proper place, a light rubber is worn on the normal mesio-distal side, while on the abnormal side a strong rubber is employed to bring the lower forward on that side.

It will be noted by studying the profile of the patient that the facial deformity is nearly the same as it is in the division. In fact, in the subdivision we find just as great a facial deformity and the mandible just as deficient (Figs. 667 and 668) on the average as we do in the division, which proves that the lack of development of the mandible is due entirely to the abnormal muscular pressure.

After the teeth have been moved into the proper position, they are retained in the same manner as described in the division. It will be necessary to wear a retaining rubber ligature on the normal side for a while to hold back the retracted superior anterior teeth, until the pressure of the lip becomes normal.

Bilateral Distoclusion with Retruding Anterior Teeth, or Class II, Division 2

In the treatment of Class II, Division 2, we have a class of cases tha are found in older patients than in Division 1. At least, the author ha never seen a Class II, Division 2 case in as young a patient as is foun

Fig. 669.

Fig. 670.

Figs. 669 and 670. Class II, Division 2 case. Side views. Bilateral distoclusion with linguoversion of anterior maxillary teeth.

in Class II, Division 1. The majority of cases and patients seen by the author during his practice, gave a history of having been mouth-breathers at one time, but probably there are other factors that also cause this condition of malocclusion. By far the greater number have had operations for adenoids or have been troubled with nasal obstruction at some time. The author is of the opinion that these patients were at some time mouth-breathers and that the abnormal muscular and atmospheric pressure has permitted the mandibular molars and teeth to assume a position distal to normal. The teeth have protruded, the tongue has

Fig. 671.—Bilateral distoclusion with linguoversion of anterior maxillary teeth, or Class II, Division 2. Front view.

been in the lower part of the mouth, and the lips have acted abnormally; then, as a result of an operation or change in environment, normal breathing has become possible and the patient, conscious of the deformity, has closed the lips, with the result that the upper and lower lips have forced the maxillary anterior teeth back against the mandibular anterior teeth. With the tongue held in the upper part of the mouth, the upper arch has developed to nearly the proper width, which development was also stimulated by nasal breathing. As a result of these factors, Class II, Division 2, differs from Class II, Division 1, in every respect except in the distal relation of the lower dental arch. The upper teeth are bunched and retruding, the upper arch nearly the normal width, the mandible nearly normal in development, and the chin

'hese last conditions have all been the re-
normal atmospheric pressure.
onditions that are present, the most suc-
uld be one that would expand the upper
sor region, expand the lower dental arch,
orward to their proper position. It will
to secure a development of the mandible
n the majority of cases the chin and man-
erefore, there is less to do, and if properly
to treat than Division 1. However, the
e difficulty arises in the treatment of Divi-
f Division 1. The reader should be cau-
these cases can be treated in a "slip-shod"

upper anterior teeth must be moved labially
will be necessary to adjust the expansion
if a case of Class I, or neutroclusion were
arch is away from the superior anterior
Wire ligatures are placed on the anterior
o the proper relation with each other. The
gnment wire, is placed on the teeth, the
the teeth moved into their proper position.
arch have been moved into the position that
upper arch has been expanded and the an-
lly, then, and not until then, should inter-
If intermaxillary anchorage is used at the
eeth are being moved, too much stress will
rs and they will be pushed distally. After
moved, the expansion arch should be ad-
rest against all of the teeth, and then all
wired to the alignment wire. This gives
pper dental arch as anchorage to move the
be necessary in some cases to place spurs
o prevent the tipping of the lower incisors.
ng been moved forward into their proper
h reciprocal and intermaxillary retention.
ained by placing bands on the first molars
is soldered on the molar and canine bands,
79. A spur is soldered on the disto-labial
hold the rubber that will be used as inter-
be observed in the upper retainer that the

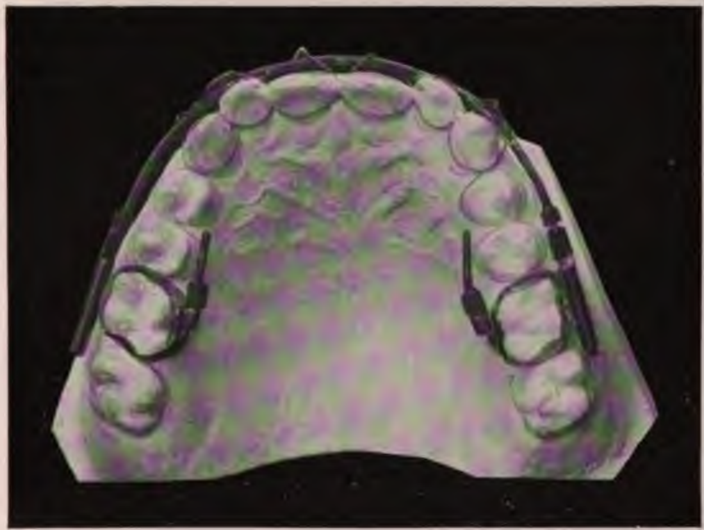


Fig. 672.

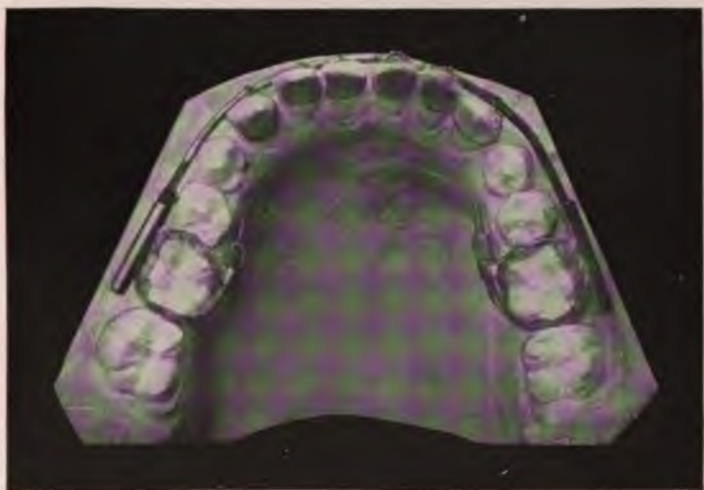


Fig. 673.

Figs. 672 and 673—Position of upper and lower appliances at the beginning of treatment.

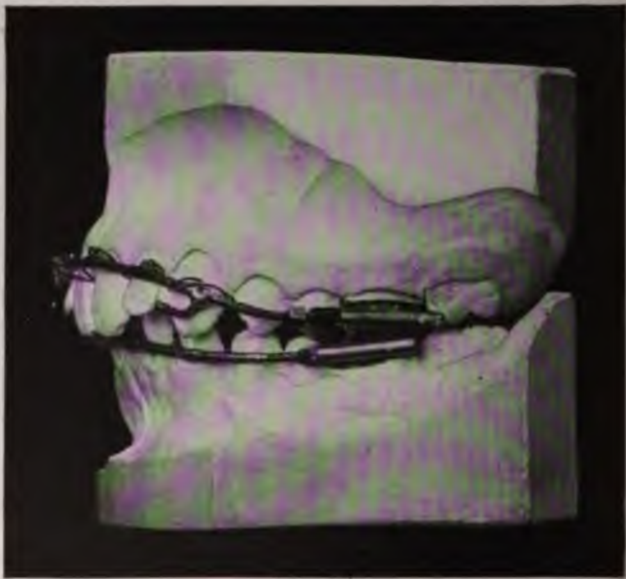


Fig. 674.

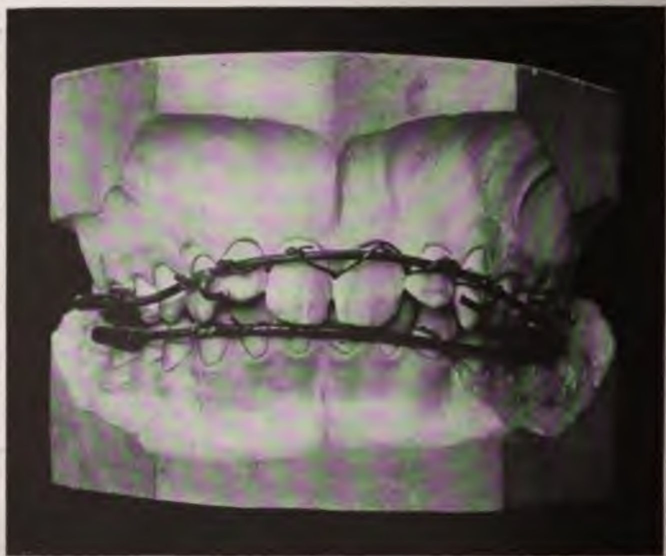


Fig. 675.

Figs. 674 and 675.—Views of the appliances as upper and lower dental arches are being expanded before intermaxillary anchorage is used.

Fig. 676.

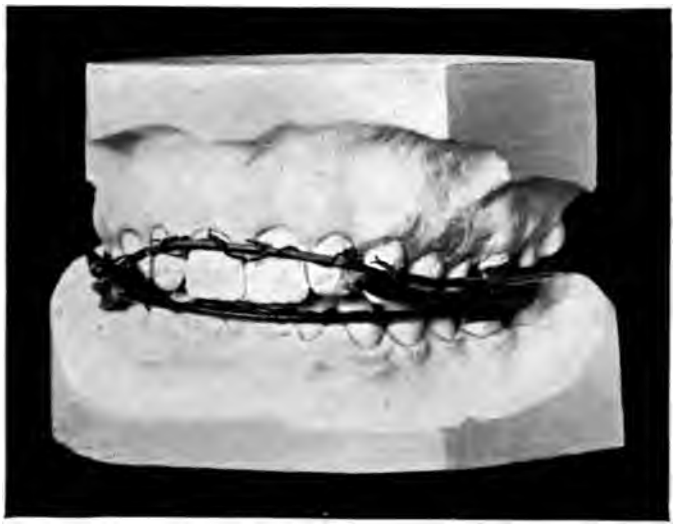


Fig. 677.

Figs. 676 and 677.—Showing use of intermaxillary anchorage after dental arches have been expanded to move mandibular teeth mesially (forward).

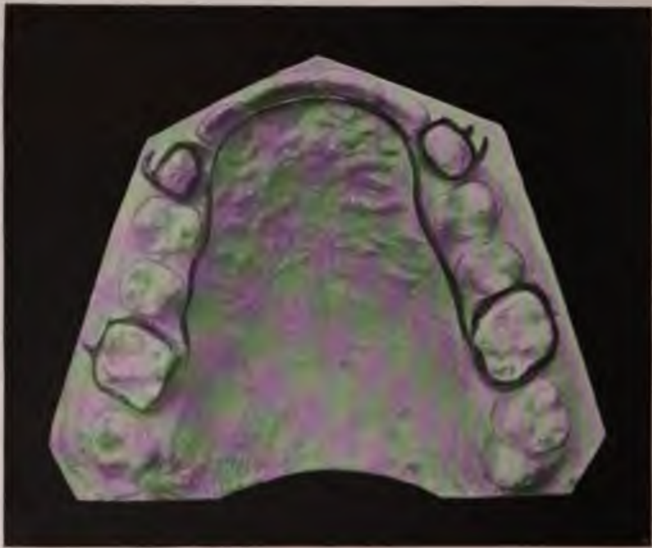


Fig. 678.

Fig. 679.

Figs. 678 and 679.—Showing plan of retention for bilateral distoclusion, or Class II, Division 2.

wire is on the lingual side of the teeth in Division 2, while in Division 1 the appliance is placed on the labial side.

The lower teeth are retained by plain bands from the molars and canines and a wire is placed on the lingual side, as shown in Fig. 679. A spur is soldered on the mesio-buccal-occlusal angle of the lower molar band to engage the lower end of the rubber that is attached to the spur on the upper canine band. The pressure of the rubbers is diminished gradually by having the patient wear lighter rubbers during the period of retention. Figs. 681, 682, and 683 show the result of the treatment.

Fig. 680.—Showing active intermaxillary retention in bilateral distoclusion, or Class II, Division 2.

Since the treatment is the same in all cases, the author feels that it is unnecessary to take up other cases here.

Bilateral distoclusion cases with bunched anterior teeth, or Class II, Division 1, in young patients and in some types of older patients can be advantageously treated with the lingual arch, as suggested by Lourie and Mershon. The case here shown is taken from Lourie's practice. Fig. 684 shows the side view of the models of a patient six years of age. There is a distal relation of the lower arch to the upper. Fig. 685 shows the occlusal view of the case, and it

Fig. 681.

Fig. 682.

Figs. 681 and 682.—Result of treatment of case shown in Figs. 669 and 670.

Fig. 683.—Front view of case shown in Fig. 676 after treatment.

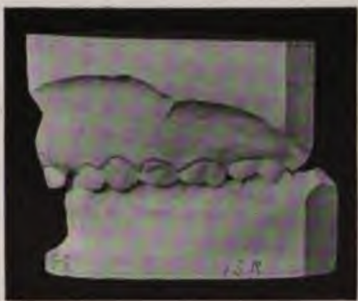


Fig. 684.—Bilateral distoclusion. (Lourie.)

Fig. 685.—Occlusal view of bilateral distoclusion case. (Lourie.)

seen that both the upper and the lower teeth require expansion in addition to the shifting of the occlusal relation, as shown in Fig. 684. Bands were fitted to the second mandibular deciduous molars and a lingual alignment wire of 19-gauge iridio-platinum was soldered to the bands, as is shown in Fig. 686. Plain bands were placed on the upper first molars and an alignment wire of 19-gauge iridio-platinum was adjusted, as shown in Fig. 686. In order to better control the expansion of the deciduous canines above, spurs were soldered to the lingual

Fig. 686.—Lingual wires adjusted to case shown in Fig. 685. (Lourie.)

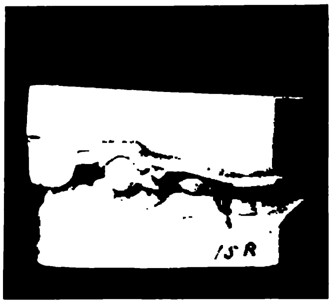


Fig. 687.—Study model of Fig. 685. Made during treatment. (Lourie.)

arch, as can be seen in the illustration. These extension spurs could be bent and thereby better control the movement of the deciduous canines. On the buccal surface of the maxillary molar band there is attached an extension for the attachment of the intermaxillary rubber; the other end of the rubber is attached to a spur on the buccal surface of the mandibular molar bands. The buccal extension for the use of the intermaxillary anchorage is shown in Fig. 687, which also shows

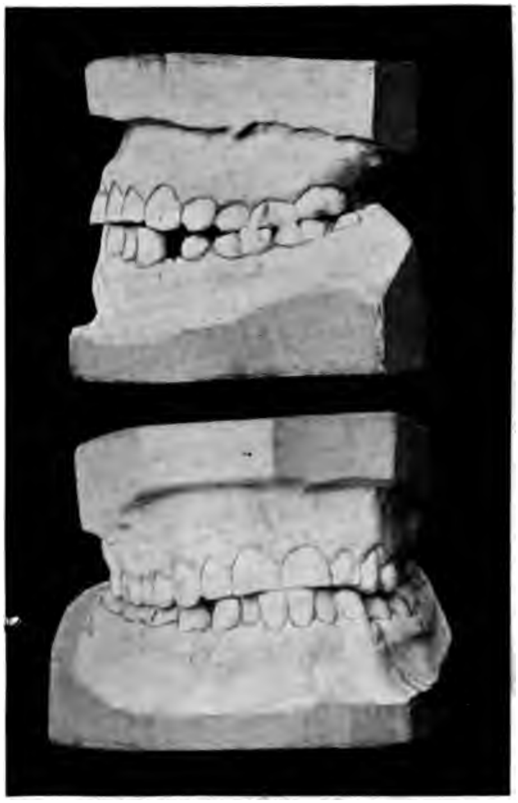


Fig. 688.

Fig. 689.

Figs. 688 and 689.—Mesioclusion, or Class III, case. A type often treated by extraction in former days.

;. This appliance is entirely inconspic-
were used on the anterior teeth and as
be seen. The very nature of the tooth
sion cases with retruding anterior teeth,
irable. Owing to the inconspicuousness
tients and parents are always greatly

with Retruding Teeth, or Class II, n 2, Subdivision

ivision of Class II, Division 2, is the
division; that is, the case is started in
naxillary ligature is only worn on the

:d on cases similar to case shown in Fig. 689. (Angle.)

sio-distal relation of the arches. There
ing the rubber on the normal side.

sioclusion, or Class III

includes those cases that have a mesial
ch. As was shown under the classifica-
types of mesioclusion, or Class III ex-
different methods of treatment. While
occlusion and normal facial outlines in
ill render necessary a different technique
or Class III, cases are more rare than
have been so in the author's practice.
the present time for the author to show
ypes, but the plan of treatment will be

Figs. 688 and 689 show a mesioclusion, or Class III, case in whi the maxillary teeth are in rather even alignment; the mandibul teeth are "bunched," and it will be noted that the mandibular fi premolars have been extracted. When the teeth are in occlusion it w be seen that there is an end-to-end bite of the anterior teeth.

This case recalls one of the common plans of treatment of this ty of mesioclusion, or Class III, cases that was followed a few yea ago; namely, the extraction of the mandibular first premolars and t distal movement of the canines and incisors until they were lingual the upper teeth. The distal movement of the canines and anteri

Fig. 691.—Mesioclusion, or Class III, case. Patient twelve years of age.

teeth was accomplished by the use of the traction screw and stationa anchorage. The appliance was arranged as shown in Fig. 690. Tl plan of treatment has not been a success and has since been discard Its application was only possible in that class of cases shown in F 688. At the present time the treatment for such a case would be described for the following case (Fig. 691).

Fig. 691, a mesioclusion, or a Class III case, is from a younger p tient than the one shown in Fig. 688, and is one that was treated wi an intermaxillary anchorage. It will be seen that the mandibular tee are mesial to the maxillary teeth the width of one premolar. The ma illary anterior teeth are lingual to the mandibular teeth.

The case demands the expansion of the upper arch and the distal movement of the lower teeth.

After having placed wire on the mesial and distal side of the first molar to procure the necessary separation, clamp-bands are fitted to the teeth with the screw and the tube occupying the proper relation. The upper expansion arch is placed on the maxillary teeth, as shown

Fig. 693. Mesioclusion, or Class III, case. Upper and lower appliances in place.

in Fig. 692. Spurs may be soldered to the anterior part of the arch (Fig. 694) so as to hold the maxillary anterior teeth stationary or perpendicular, thus giving more resistance to the maxillary teeth, which is needed to move the mandibular teeth distally. With all of the maxillary teeth ligated to the expansion arch, we have firm anchorage.

However, the resistance of the maxillary teeth to forward movement can be increased by bending and springing the upper alignment wire. In adjusting the alignment wire on the maxillary teeth, the tubes are so aligned that the anterior portion of the arch occupies a position high on the gingival portion of the teeth, as shown in Fig. 695. Then, by springing the arch occlusally and wiring it to the teeth, a backward

Fig. 693.—Position of lower arch, showing intermaxillary anchorage.

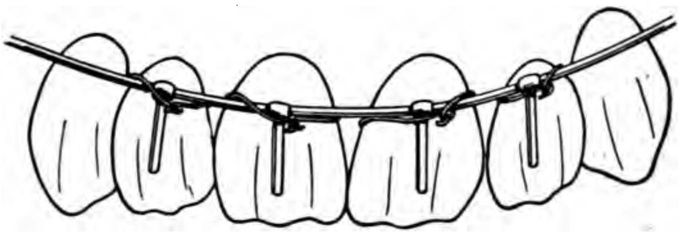


Fig. 694.—Spurs to produce bodily movement of anterior teeth and to make stationary anchorage of teeth in upper arch to move mandibular teeth distally in Class III.

force is brought to bear on the upper molars (Fig. 695). If the arch should be left this way without any counteracting force, the maxillary molars would be tipped distally. However, in mesioclusion, or Class III, cases the maxillary molars are prevented from moving distally by the pull of the intermaxillary rubbers, which exert a forward pull on the maxillary teeth. As a result of the spring of the arch that exerts a backward tipping on the molars, and the forward pull of the intermaxillary rubbers, the maxillary teeth remain stationary and become the anchorage that moves the mandibular teeth.

In adjusting the alignment wire to move the lower teeth distally, the anterior position of the arch does not rest against the lower anterior teeth. This is because we desire to exert all of the force upon the mandibular molars and move them distally first. The position of the lower arch is shown in Fig. 692. No ligatures are placed on the mandibular anterior teeth, for all of the force is to be exerted on the mandibular molars. With all of the force exerted against the man-

Fig. 695.—Position of arch high on gingival portion of teeth to make stationary anchorage on molars when arch is sprung down as shown in Fig. 696.

Fig. 696.—Upper arch bent occlusally and wired to make molars stationary.

dibular molars, they will be moved distally, and in the majority of cases the premolars will follow them. In the treatment of the case, as the molars move distally and a space is left between the molars and premolars, a wire ligature, as shown in Fig. 697, is placed around the first premolar and attached distally to the tube on the molar band. This ligature can be tightened and a stress exerted upon the premo-

lars, which brings them toward the molar. Spurs may be placed on the arch slightly distally to the premolars, and each tooth ligated to the arch; then, by screwing the nut on the lower expansion arch forward to such position that it does not rest against the tube, the pull of the intermaxillary rubber moves the mandibular premolars distally. This application of the alignment wire is shown in Fig. 698. As the molars and premolars move distally, it is then possible to place wires on the canines and expand in the canine region. Spurs can be placed on the lower arch in such positions as to exert a distal pull on those teeth. After the teeth are moved into the proper position, the maxillary teeth are retained by placing plain bands on the molars and premolars, with

Fig. 697.—Application of ligature around premolars and distal end of molar tube to move premolars distally.

a wire soldered to the lingual surface of the bands. On the mesio-buccal angle of the molar bands (Fig. 699) a spur is soldered to engage the intermaxillary rubber to be used in retention. On the mandibular teeth plain bands are made for the molars and canines. A wire is placed on the labial side of the incisors and soldered to the labial surface of the canine bands, as shown in Fig. 700. A wire is soldered on the lingual side of the molars and canines. On the disto-labial angle of the canine band a spur is soldered, engaging the intermaxillary rubber that extends from the spur soldered to the maxillary molar bands. The wearing of the intermaxillary rubbers maintains the mesio-distal relation of the teeth.

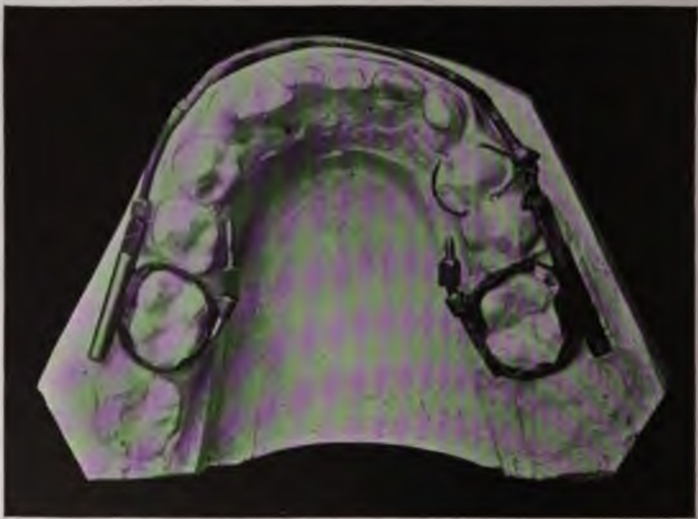


Fig. 698.—Spur soldered to arch to engage ligature that holds premolar to arch and causes it to move distally as a result of the intermaxillary anchorage.

Fig. 699.—Upper retainer for mesioclusion, or Class III.

In the treatment of mesioclusion, or Class III, cases, there is a grea tendency to elongate the molars, both the upper and lower. Howevei the greater danger lies with the mandibular molars, owing to th manner in which the stress is brought to bear on those teeth. Therє fore, the teeth must not be moved too fast, as the slow movement c the teeth prevents the elongation.

Figs. 701 and 702 show another case of mesioclusion, or Class II that was complicated by open-bite. An attempt had been made t correct the open-bite by extracting the second and third mandibula molars and by grinding off the occlusal surface of the mandibular fir molars. The lower molars are in buccal occlusion and the upper arc

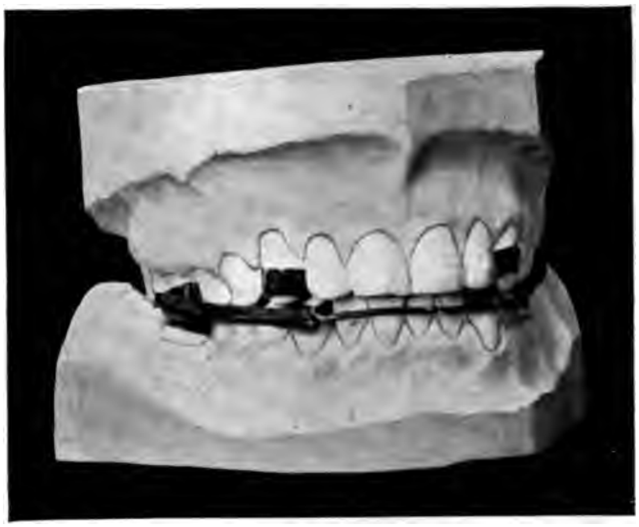


Fig. 700.—Showing intermaxillary retention of mesioclusion, or Class III.

is slightly narrow. There is very little malocclusion of the upp teeth. The lower anterior teeth are slightly bunched and are inclinir lingually. With the lingual inclination of the mandibular teeth it b comes necessary to move the apex of the teeth as well as the crown or the tipping will be more noticeable.

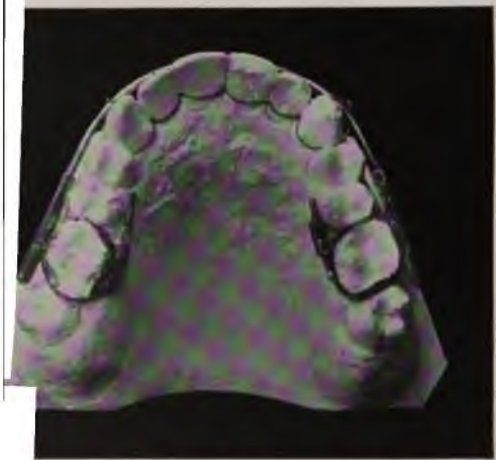
The expansion arch was placed on the maxillary teeth, as shown Fig. 703, all of the teeth being ligated to the arch in order to make tl upper teeth as rigid as possible. As the mandibular molars were buccal occlusion, the expansion arch was adjusted with an acti spring force toward the lingual in the molar regions. The relation the ends of the expansion arch to the molar bands is shown in Fi

Fig. 701.

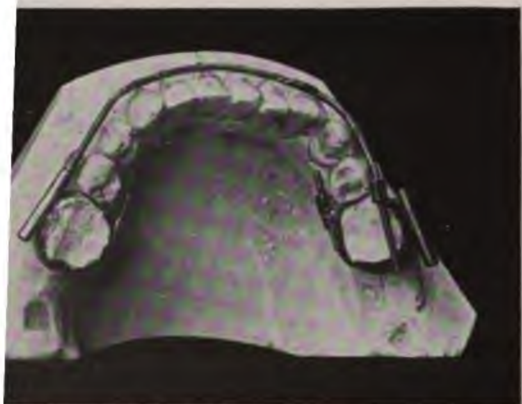
Fig. 702.

Figs. 701 and 702. Mesioclusion, or Class III, case. Open-bite and narrow upper arch.

ansion arch is inserted in the tubes on the molar
e will be exerted on the teeth that will narrow the
e dental arch. In putting the expansion arch in
ngual force is exerted on the molars, it is always



eeth ligated to make stationary anchorage in molar region.



how arch was bent to move mandibular molars lingually.

arch in place, for the lingual spring will throw the
es. While the mandibular molars are being moved
rmaxillary rubbers are worn from the hooks that
lower arch in the region of the canines to the tubes

on the maxillary molar bands. After studying the case, it was decided to elongate the mandibular incisors in order to close the open-bite. Therefore, the lower expansion arch occupied a position along the incisal border of the teeth. Wire ligatures were placed around the teeth and twisted tightly to prevent them from slipping over the gingival marginal ridge of the teeth; then the ends of the wires were brought around the arch and twisted. This springs the expansion arch

Fig. 705.—Ends of lower arch in tubes and ligated in place.

Fig. 706.—Showing spurs on lower arch to keep mandibular teeth upright.

gingivally and exerts a force on the mandibular teeth so as to elongate them. In order to keep the mandibular teeth in their upright position and to move the apex of the teeth distally, spurs are soldered to the lower arch, as shown in Fig. 706. The mandibular anterior teeth should be elongated to very nearly the desired length before they are ligated to the arch and spur; for, in order that the spur will be effec-

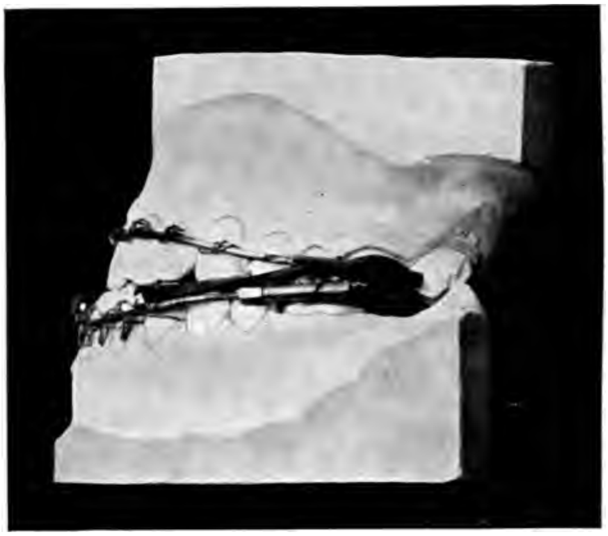


Fig. 707.—Side view with intermaxillary anchorage.

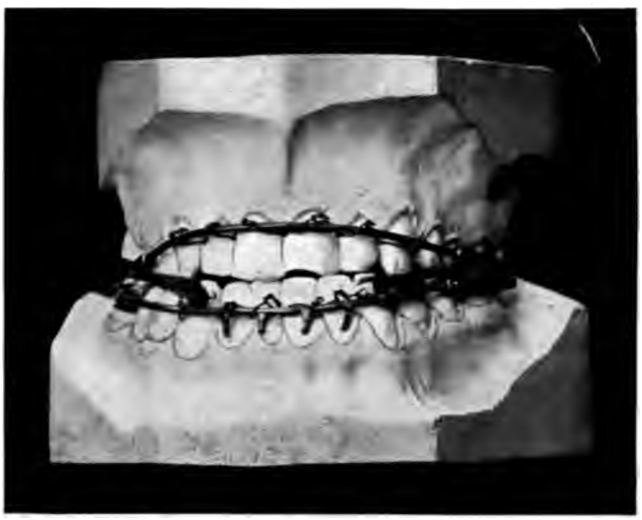


Fig. 708.—Front view with intermaxillary anchorage.

ld the tooth
placed under
ll be carried
views of the

case at the
placed on t

Figs. 711 and 712.–

much the reg
appliances are

case at the time the regulating appliance was removed and a retainer placed on the teeth. The rear view (Figs. 711 and 712) shows how

Fig. 711.

Fig. 712.

Figs. 711 and 712.—Showing effect of moving lower molars lingually. Fig. 711, before treatment; Fig. 712, after treatment.

much the region of the lower molars was narrowed. The retaining appliances are the same as those described in the previous case, with

the addition of small spurs on the lingual side of the lower labial wire, which engage the approximal sides of the lower teeth. These spurs keep the teeth in their proper position, occluso-gingivally. Intermaxillary rubbers are worn to keep the teeth in their proper mesiodistal relation, extending from the spur on the maxillary first molars to the mandibular canines.

For the purpose of producing a distal movement of the apices of the mandibular incisors in mesioclusion, or Class III, cases, the pin-and-tube appliance is very desirable, as the pins can be adjusted to produce an apical movement. In order to increase the action of the pin and to give it a greater range of elasticity, the pin can be extended and bent in the form of a hook (Fig. 713) and placed in the tube from the occlusal side. This application, which was suggested by Lourie, allows the labial arch to be out of sight, as it is entirely covered by the lip, which is a great advantage over the old form where the arch occupied a position near the occlusal edge of the teeth. Lingual arches can also be employed in a great many cases of mesioclusion and offer the same advantages that they do in other types of malocclusion, namely, delicacy and inconspicuousness.

Fig. 714 is a case of mesioclusion in a patient of advanced age who was very sensitive in regard to having any appliances show. Plain bands were placed on the maxillary first molars carrying small tubes for the purpose of receiving the ends of the lingual arch, which was held in place by a lock similar to the others described in the construction of lingual arches. Plain bands were also placed on the mandibular molars and the lingual arch was soldered to the bands. On the buccal surface of the mandibular molar bands, was soldered an extension for the purpose of receiving the intermaxillary ligature. The extension is shown in Fig. 716. A small spur was soldered on the buccal surface of the upper molar band to engage the intermaxillary rubber that extended to the buccal extension of the lower molar. By pinching the upper lingual wire, the necessary expansion was produced. The change in the mesio-distal relation of the arches is shown by comparing Fig. 714 with Fig. 715. This appliance can be made less bulky and less conspicuous by attaching the intermaxillary rubber to the lingual arches, as Lourie is doing with later cases.

Unilateral Mesioclusion, or Class III, Subdivision

Figs. 717 and 718 show a case of the unilateral mesioclusion, or Subdivision of Class III. The dental arches are normal mesio-distally on one side, and mesial on the right. In looking at the front view of

Fig. 713.—Spring extension to be used for apical movement in mesioclusion cases.

Fig. 714.

Fig. 715.

Fig. 716.

Figs. 714, 715 and 716.—Case of mesioclusion treated by the use of lingual arches. (Lourie.)

the case, it will be seen that the upper lateral incisors are in lingual occlusion. The palatal view (Figs. 719 and 720) shows great contrac-

Fig. 717.—Normal mesiodistal side of unilateral mesioclusion, or Class III, Subdivision case.

Fig. 718.—Front view of Class III, Subdivision case.

tion or rather lack of development of the upper dental arch, all of the molars and premolars being in lingual occlusion.

In applying the expansion arch to the maxillary teeth, clamp bands are placed on the maxillary first molars after separation has been gained by the use of a ligature wire. The bands are so adjusted that the tubes will occupy a position that will enable the arch to lie near the gingival portion of the teeth. The expansion arch in the canine region is left rather square, as shown in Fig. 719, as the canines must be moved buccally. Soft-solder spurs are placed on the arch buccally to the canines so that it will be possible to move these teeth directly buccally. Before the arch is placed in the tubes on the molar bands, the ends of the expansion arch should occupy a position to the tubes as shown in Fig. 723. If the distal part of the arch is farther buccally to the tube than is the mesial part, the tooth will be rotated. The canines and premolars are ligated to the arch and after the canines have been moved slightly, or enough to make some space, the ligatures are placed on the lateral and they are moved into position.

Clamp-bands are placed on the mandibular first molars and the tubes are so placed that they will permit the arch to occupy a position near the gingival border of the teeth. As it is necessary to move the lower teeth on the right side distally, an intermaxillary-hook is soldered to the lower arch opposite the right canine. An intermaxillary-hook should also be placed on the left side of the arch opposite the canine, not to move the mandibular teeth distally, but to be used to reënforce the maxillary molar, for in moving the maxillary left lateral over the mandibular teeth the upper molar is sometimes forced distally. With the intermaxillary-hook on the lower arch, an intermaxillary rubber can be used to prevent such occurrence. The anterior portion of the lower expansion arch stands away from the teeth, and the intermaxillary ligatures exert all of the force on the mandibular right molar. No rubber ligature is placed on the left side, unless it is necessary to reënforce the maxillary molar anchorage. After the mandibular molars begin to move distally, if a space is developed between the molars and premolars, ligatures should be put on those teeth to move them distally, after the manner described in the treatment of the full division. The author does not consider it at all advisable to allow the molars to be moved away from the premolars any distance; for it destroys the approximal contact of the teeth, disturbs the fibers of the peridental membrane that run from the cementum of one tooth to the cementum of the other, and makes retention more difficult. The lower right canine must also be moved in turn as the molars are moved. The author wishes it distinctly understood that he does not advocate starting all of the mandibular teeth on one side at once; but as soon

Fig. 719.—Occlusal view with upper arch adjusted.

Fig. 720.—Occlusal view with lower arch adjusted.

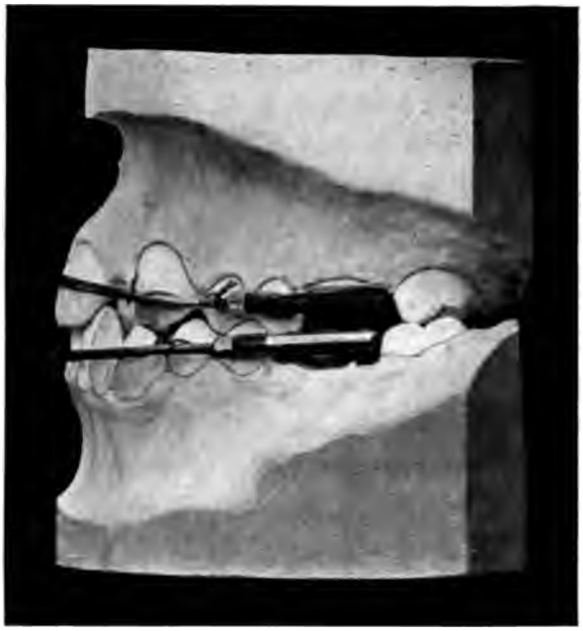


Fig. 721.

Fig. 722.

Figs. 721 and 722.—Side views showing intermaxillary anchorage used on mesial side of lower.

as there has been sufficient tissue change around the molars so that they will start to move, the premolars and the canine must have force brought to bear on them in order that they will move distally together and hold the teeth in their proper approximal relations.. After the molars, premolars and canines have been moved to their proper place, or nearly so, the anterior mandibular teeth can then be moved to the desired position.

The retention of the maxillary teeth consists in the use of the plain bands on the first molars and canines with a lingual retaining wire soldered to the bands. On the mesio-buccal angle of the upper molar

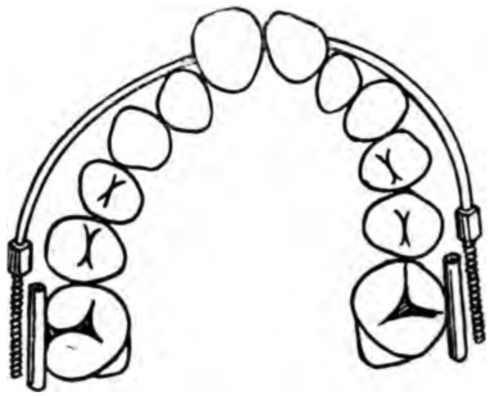


Fig. 723.—Application of arch to expand molars without rotating same.

band, a spur is soldered that will engage a rubber ligature to be used for intermaxillary retention. The lower retainer in this case will consist of the same device as was used in the bilateral case (Fig. 700), except that on the mandibular left canine band no spur is soldered on the disto-labial angle to engage the intermaxillary rubber.

As the teeth become locked by the inclined planes and the approximal relation of the contact point, the wearing of the rubbers can be discontinued gradually.

Since the treatment of any one case of the subdivision is very much the same as any other, these cases need not be discussed further here; however, it must be remembered that the cases of this particular type are generally progressive, and both the division and the subdivision should receive early attention.

CHAPTER XII

MALOCCLUSION AND NASAL DEFORMITIES

It has long been recognized that there is a relation existing between malocclusion of the teeth and deformities of the nasal cavity, but there has been some dispute in regard to what relation one has to the other and which is the causative factor and which is the effect. In considering the etiology of malocclusion, we have learned that a certain number of malocclusions are caused by mouth-breathing, which is produced by abnormal forces of occlusion that result from a disturbed function of the muscles and abnormal atmospheric pressure. It has also been observed that associated with certain types of malocclusion we almost invariably have certain types of nasal deformity. It has long been recognized that there are certain types of nasal deformities associated with certain malocclusions that cannot be improved to any great extent, unless the treatment is in conjunction with the correction of malocclusion.

There are a certain number of individuals who are suffering from mouth breathing in which the mouth-breathing has undoubtedly been caused by hypertrophy of the lymphoid tissue in the naso-pharynx, and upon removal of this lymphoid tissue the mouth-breathing still persists. This is because the abnormal action of the muscles and abnormal atmospheric pressure during the time the individual has been a mouth-breather has produced a malocclusion and along with the malocclusion has been produced a deformity or abnormal development of the nasal cavity. We are then naturally confronted by the question as to what relation exists between malocclusion of the teeth and deformed nasal cavities, which is the causative factor and which is the effect, and what benefit can be expected to be derived from the correction of malocclusion so far as the deformed nasal cavity is concerned. Considering the relation between malocclusion and deformed nasal cavities, it is well to remember the anatomy of the parts concerned. It must be remembered that the nasal and oral cavities as we find them in the adult, have at one time been a common cavity, which may be described from an embryologic standpoint as consisting of a single opening at the anterior end of the alimentary canal which is known as a stomodium. We must also bear in mind the fact that in the early life of the individual, the nasal and oral cavities are one cav-

ity without any separating structure, or, in other words, the hard and soft palate has not yet developed to separate the nasal from the oral cavity.

In the development of the nasal and oral cavity, we find that the first branchial arch and the fronto-nasal process play a very important part. The first branchial arch divides into two parts: one of which is known as the mandibular portion and is the lower part, and the upper

Fig. 724.—Drawing showing embryonic development of roof of mouth. (His.)

Fig. 725.—Cross section of developing nasal and oral cavity of embryo pig. (His.)

Fig. 726.—Cross section of developing nasal cavity after the union of the palatal processes of the superior maxillæ. (His.)

part known as the maxillary portion which grows from the superior right and left side of the mandibular arch and finally unites with the frontal-nasal bud in that region that may be compared to the lip or alveolar border. From the inner posterior part of the first branchial arch there grows off a shelf or offshoot, which finally unites in the median line that forms the hard and soft palate. It is a formation of the hard and soft palate that separates the nasal from the oral cavity.

The development of these parts can be observed in Fig. 724, which is copied after His. Another structure or development that we must consider in relation to malocclusion and deformity of the nasal cavity is the development of the nasal septum, the turbinated body shown in Fig. 725. Growing downward from the base of the cranium or from the chondro-cranium we have a cartilaginous structure, or rather structures, which make up or contribute to what is known in later life as the nasal septum. Growing down from the horizontal plate of the ethmoid we have the perpendicular plate of the ethmoid, which grows downward into the nasal cavity toward the median line or the junction of the hard palate. From the base of the sphenoid, we find another cartilaginous structure that grows forward, which is known as the cartilaginous vomer. It is later replaced by intramembranous bones developing on the right and left side of the cartilage. Associated with the perpendicular plate of the ethmoid and the vomer we have a cartilage known as the triangular cartilage, which completes what is later known in life as the nasal septum. The downward growth of the perpendicular plate of the ethmoid and the vomer occurs regardless of the development of the lateral halves of the nasal cavity. It occurs regardless of the development of the floor of the nose and it is this factor that must be kept in mind in considering the relation of the deformity of the nasal cavity in relation to malocclusion. As the nasal septum grows downward from the chondro-cranium, the horizontal plate of the superior maxillary bone, which has been developed in the maxillary bud of the first branchial arch, grows toward the median line and the structures unite at the median line forming the floor of the nose, the nose being divided by the nasal septum into the right and left nares. The embryonic development of the nasal septum and the floor of the nose is shown in Fig. 726. Fig. 727 is a posterior view of the maxillary bone and the mandible, showing the bony wall of the oral cavity and the nasal cavity as viewed from the posterior border. It will be seen that the hard palate or the roof of the mouth also forms the floor of the nose, that the right and the left half of the nares is made up by the perpendicular plate of the superior maxillary bone or the nasal process of the superior maxillary, while the superior lateral wall of the nose is made up of the lateral mass of the ethmoid.

The horizontal plate of the ethmoid, assisted by a small part of the frontal and body of the sphenoid bone, forms the roof of the nose. It then gives us the nasal cavity completely surrounded by a bony structure and separated by the nasal septum. The nasal cavity is separated into the right and left nares by the nasal septum, which has grown

downward from the perpendicular plate of the ethmoid, the body of the sphenoid, and which grows toward the roof of the mouth in the median line. The nasal septum is primarily of cartilaginous origin and is replaced by an osseous structure. Physiologically the nasal septum has nothing to do with respiration. From an evolutionary standpoint the vomer was originally a tooth-bearing bone and has been walled off in the nasal cavity during the process of evolution.

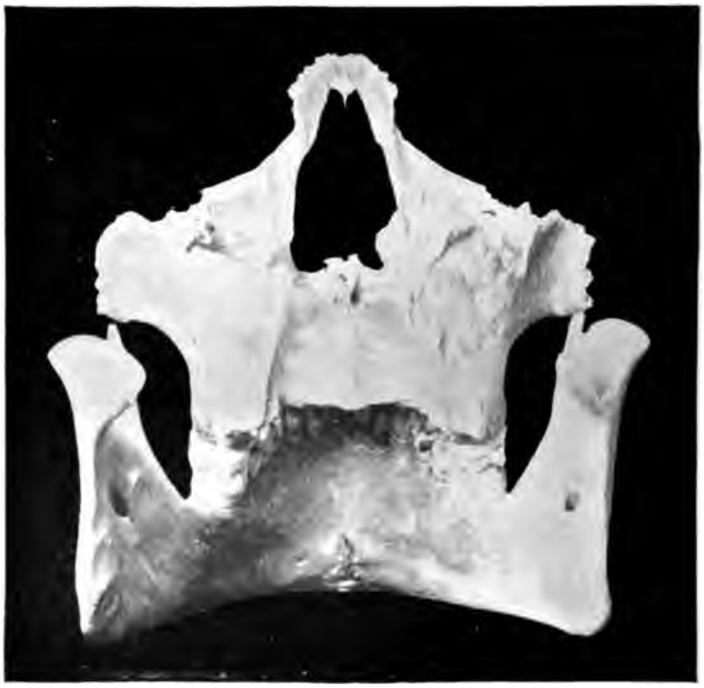


Fig. 727.—Posterior view of nasal cavity showing bony cavity which contains the nasal septum.

As we study this question further, we find that the factors that affect the development of the lateral walls of the nasal cavity and the floor of the nasal cavity do not necessarily affect the septum. As a result of this, we find certain types of malocclusion in which the nasal cavity does not develop as rapidly as it should. The nasal septum will continue to grow downward and as it meets with resistance from the floor of the nose will become deflected. Fig. 728 is a diagram showing the various parts of the nasal septum, of which *T C* is a triangular cartilage, *E* is the perpendicular plate of the ethmoid, and *V* the vomer. It will be

observed that the vomer grows downward and forward originally in cartilage, and is later replaced by intermembranous bone development on both sides of the cartilage, and the cartilage disappears. The vomer may thus be considered a double structure composed of a right and a left side. The perpendicular plate of the ethmoid grows downward from the horizontal plate of the ethmoid and joins the vomer and the triangular cartilage. The anterior part of the nasal septum is completed by the triangular cartilage, which is also subject to a great many deformations that may be the result of abnormal development of the nasal cavity as the result of injury. An examination of Fig. 728 will show that the nasal septum is enclosed between two bony walls or surfaces, which are the roof of the nose and the floor of the nose. The distance between the floor of the nose and the roof of the nose is dependent upon

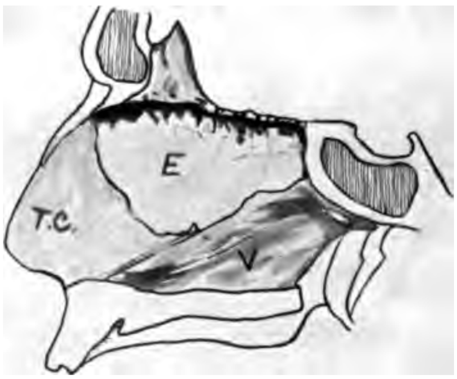


Fig. 728.—Diagram of nasal septum. *T.C.*, Triangular cartilage; *E.*, Perpendicular plate of ethmoid; *V.*, Vomer.

the development of the lateral wall of the nose, the principal part of which is the superior maxillary bone. Therefore, if any condition arises that interferes with the growth of the superior maxillary bone, it necessarily will cause a shortening between the floor of the nose and the roof of the nose. The nasal septum will be compelled to occupy a smaller space than it was originally intended to occupy.

It is also a fact that conditions that affect the development of the lateral wall of the nose do not affect the nasal septum. Therefore, in a great many types of malocclusion we find that deflected nasal septi are the result of the lack of development of the lateral walls of the nasal cavity and the superior maxillary bone, which have resulted in a lack of distance between the roof of the nose and the floor of the nose.

Fig. 729 shows a fetal skull at birth, and at this time the bony septum or nasal septum is enclosed in the bony walls of the nasal cavity. It will also be observed that the roof of the mouth is comparatively flat; that the alveolar process is close to the orbital cavity; and that there must be great increase in distance between the floor of the orbital cavity and the alveolar process as the individual develops. The inferior turbinated bone is very close to the roof of the mouth or floor of the nose, with the result that as the individual grows, the nasal cavity increases

Fig. 729.—Nasal septum enclosed in nasal cavity.

in length, especially between the inferior turbinated bone and the floor of the nose.

As this floor of the nose is carried downward by the development of the lateral walls, space is made for the nasal septum, and if development goes on harmoniously we find that a development occurs in the adult that is the same as we find in Fig. 730. From above downward there is a tendency for the nasal septum to separate into two parts, showing the tendency for the organ to be developed into a right and a left part.

Fig. 731 is the posterior part of Fig. 730 and it shows the shape of the roof of the mouth, which is a beautiful arch, by the development of the maxillary sinuses and the increased distance between the turbinated bones and the floor of the nose. This skull may be considered

Fig. 730.—Nasal cavity of an adult.

as showing a normal development and as one in which there is a normal nasal cavity associated with what was a normal occlusion. In certain types of malocclusion, which may be neutroclusion, or Class I, com-

plicated by lack of development of the dental arches, or which may be distoclusion complicated by labioversion of the upper incisors (Class II, Division 1), or in fact in any individual who is a mouth-breather, we are very apt to have an abnormal development of the nasal cavity because of the abnormal development of the superior maxillary bone.

If the lateral walls of the nasal cavity do not grow downward rapidly enough, there will be a decrease in distance between the floor of the nose

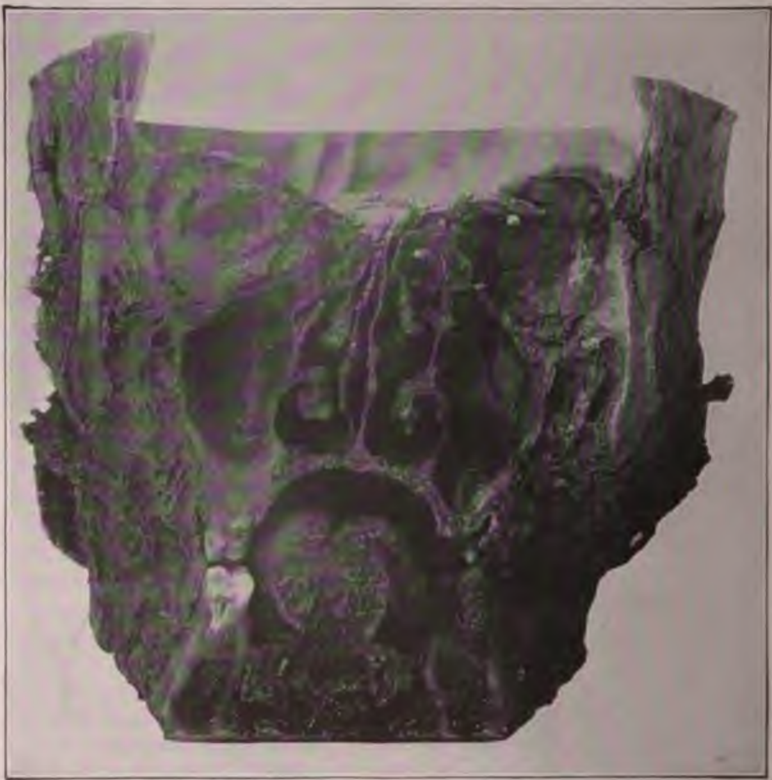


Fig. 731.—Showing double plates of nasal septum.

and the roof of the mouth, which will result in a deflected septum. The removal of adenoids does not benefit this condition, because the only thing that will restore the development of the nasal cavity to the proper size is the treatment of the malocclusion that will produce the proper growth of the superior maxillary bone and result in changes in the entire nasal cavity. It has long been recognized by the many authorities that the correction of the malocclusion always produces a beneficial re-

result in the deformity or lack of development of the nasal cavity. This observation has led to several plans of treatment, some of which are based on the correction of malocclusion only with the resulting change in the nasal cavity, while other plans of treatment are based upon the correction of the malocclusion with the idea of improving the nasal cavity by changing the shape with mechanical interference.

A number of cases, reported several years ago by Ketchum, showed that, in the treatment of malocclusion in patients who were mouth-breathers, the nasal cavity increased very materially in size and that deflected septi disappeared or improved during the process of treatment. Observations made in the author's practice have substantiated this fact, so that we can state that the correction of the malocclusion in the young individual, when the superior dental arch is not properly developed, will practically remove the deflected nasal septum. It has also been observed that in older individuals who were suffering from nasal stenosis in which there was insufficient space in the nasal cavity, especially in a lateral direction, by an expansion of the dental arch an increased nasal space is produced and normal breathing becomes possible.

By studying Figs. 727, 730, or 731 from a purely mechanical standpoint, it will be seen that any device or kind of treatment that will expand the dental arch and expand the alveolar process of the superior maxillary bone will necessarily produce some change in the width of the nasal cavity. The change in the width of the nasal cavity can be produced in several ways. It must be remembered that the teeth are embedded in the peridental membrane, which is a continuation of the muco-periosteum that covers the floor of the nose and the roof of the mouth, and which is made up of white inelastic fibers. By an expansion of the dental arch, stress is brought to bear upon the fibers of the peridental membrane, which in turn is transmitted to the periosteum covering the floor of the nose and roof of the mouth. This exerts an influence upon the floor of the nose to such an extent that the shape of the floor of the nose will be changed, and with individuals who have high narrow arches the roof of the mouth will be changed to one which is wide and broad. If the nasal cavity is examined in these individuals before treatment is begun, we will observe that either the nasal septum is deflected or there is a lack of width between the lateral walls of the nose. As the change occurs in the roof of the mouth and as the nasal cavity is again examined, it will be found that the nasal septum has straightened and that there has been an increase in width between the lateral walls of the nose. In other words, there has been a

change in the roof of the mouth in that the roof of the mouth has become wider and has come farther downward from the base of the cranium.

Some of this change in the roof of the mouth is the direct result of mechanical pressure, while more of it is the result of a growth produced by mechanical stimulation, and the result of cell metabolism and changes in the structure as a result of natural growth. It must be remembered that the superior maxillary bone is a bone of environment and responds to mechanical influences and stress; and that by changing the position of the teeth so as to change the stress upon the bone, the entire superior maxillary bone will be changed in the growing individual. In fact, a great change will also occur in older individuals, which has been observed in the author's practice. The cases that Ketcham reported and the cases observed in the author's practice were changes that were produced by ordinary orthodontic treatment or that were the result of slow and gradual pressure upon the teeth without making any direct effort to change the shape of the maxillary bone as the result of direct mechanical pressure.

A number of others have reported cases in which the superior maxillary bone has been changed in shape and in which the nasal cavity has been changed by exerting pressure upon the teeth and the superior maxillary bone with the idea of changing the shape of the roof of the mouth as a result of direct mechanical pressure. This treatment has been based upon the idea that by pressure the median suture between the right and left superior maxillary bones could be opened, and as the result of the opening of this suture a lateral expansion of the nasal cavity would occur.

While the author has never followed this plan of treatment in active practice, nevertheless he is convinced that it is possible to open the intermaxillary suture by the construction of special appliances, and in fact, it may be done in some cases with any appliance. The author has done this experimentally upon dogs at different times without any seemingly ill effect upon the dogs and with the result that the bone has filled in the open suture and the nasal cavity has been increased in width. There is no question but what there are extreme cases of nasal stenosis, narrow dental arches with high palate, in which it is desirable to construct some style of appliance especially suited to widen the lateral halves of the superior maxillary bone, not so much with the idea of opening the median suture as with the idea of producing a bodily movement of the teeth and of carrying out the lateral halves of the superior maxillary bone as much as possible. This can be pro-

duced by constructing appliances that consist of bands placed upon the molars and the canine teeth, or upon the teeth of the two lateral halves of the arches, and then, by the use of alignment wires in such a manner that a direct buccal pressure is exerted upon the teeth, they are forced to move bodily, thereby carrying the superior maxillary bone or alveolar process with them in a bodily direction.

In younger individuals who have only the deciduous teeth, or deciduous molars and permanent molars, the construction of an appliance for the purpose of producing bodily movement is very unsatisfactory if the appliance is attached directly to the teeth, because it will loosen the deciduous teeth. However, we find that the cases at this age are the most desirable for treatment. To overcome the difficulty encountered with loose deciduous teeth, the use of the plate has been employed to exert pressure upon the alveolar structures through the soft tissue.

The old Coffin split plate presented some advantages in the treatment of these cases. The idea has later been modified by others, including a device that was published several years ago by Ottolengui, and a modification of a common split plate that is used at the present time by Richardson. As a result of the use of this appliance the patients report a great improvement in the nasal breathing, improvement in speech, and individuals who before the treatment were able to breathe through their mouths only now breathe through their noses entirely during the day and night.

The appliance, by exerting a gentle pressure on the soft tissues, carries the lateral halves of the superior maxillary bone laterally either by direct mechanical influence or by development. The roof of the mouth is changed, the nasal cavity increased in width, and the deflected nasal septum is straightened because of the increased room that is made for it. The author does not believe that the changes that occur in all of these cases are the direct result of mechanical pressure but that they are the result of mechanical stimulation of the cells, which produces a development that has been retarded, and consequently the parts assume a normal proportion in shape resulting in a normal development of the nasal cavity following the correction of treatment of malocclusion.

Fig. 732 shows a model of a young patient in which the only permanent teeth present are the first permanent molars with a high narrow arch. The patients suffer from mouth-breathing and invariably show deflected nasal septi and nasal cavities that are below the normal width. The removal of adenoids or tonsils that are usually present does not improve the nasal breathing because of the deformed nasal cavity.

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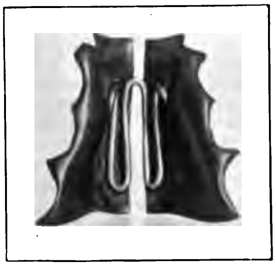
ılate with spring for expansion of upper arch. (Richardson.)

ling, and therefore the alignment wire must be used ı the upper incisors in cases where some of the upper ed.

ənts where the permanent incisors have not erupted, treatment necessary at this time is the widening of l arch, so far as the upper teeth are concerned. Al- ·us teeth to assume such positions as they will assume



view of roof plate for expansion of arch. (Richardson.)

ınge in the atmospheric and muscular pressure, and ·e that if sufficient space is made for the upper cen- the individual is a normal breather at the time they ıke their normal position. If it is necessary to use anchorage to correct the mesio-distal length of the se of this roof plate, intermaxillary hooks can be

tion of the labial arch with the finger spur, as used by Lourie and employed in conjunction with the roof plate as used by Richardson, gives a very ideal appliance for the treatment of patients who suffer from deformed nasal cavities, narrow arches, high palates, in which it is desir-

Fig. 737.—Showing nasal septum bent from before backward.

ous to move the teeth bodily by pressure on the alveolar process, and produce as great a change in the nasal cavity as it is possible to produce. In the increase of width of the dental arch and in the increase of

space in the nasal cavity, deflected septi are corrected provided that the deflection is from above downward.

Such deflections as are shown in Fig. 737 are from before backward and are probably the result of traumatism. They are not corrected or benefited to any great extent by the correction of malocclusion. In beginning the treatment of a malocclusion it is very necessary to make a careful diagnosis of the malocclusion and a careful examination of the nasal cavity in order to learn the exact condition of the nasal structures. Then the appliance must be selected with the idea of producing as nearly as possible the ideal results. While it is possible to produce a great change in the nasal cavity, care must be taken not to promise the patient too much; and to remember that only certain types of deflected nasal septi can be corrrected.

It is our belief that in the majority of cases in which there is a lack of width between the lateral walls of the nose, this can be changed by proper treatment; that the nasal cavity can be caused to increase to its proper size, and that a great benefit can be produced as far as respiration is concerned, provided that the proper treatment is instituted. In a large number of nasal deformities there is nothing that offers as much benefit as the proper correction of the malocclusion with the idea of producing a normal nasal development.

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